SUPPLEMENT

TO THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. VII. LONDON, AUGUST 31, 1858. No. 153.

Legal Intelligence.

SURREY ASSIZES.

GUILDFORD.—TUESDAY, AUGUST 10.

(*Before Baron* BRAMWELL *and a Special Jury.*)

HILLS *v.* THE LONDON GASLIGHT COMPANY.

The ATTORNEY-GENERAL (specially retained), with whom was Mr. MONTAGUE CHAMBERS, Q.C., Mr. HINDMARCH, and Mr. POLLOCK, appeared for the plaintiff; and Mr. BOVILL, Q.C., with Mr. LUSH, Q.C., Mr. WEBSTER, and the Hon. Mr. DENMAN, appeared for the defendants.

The jury consisted of Messrs. John Colman, William Cooper, Edward Charleton, Samuel Dixon, William Evans, John Sprigg Feltoe, Crawford Davidson, John Sparkes, James Simmons, Joseph Martindale Harrison, Robert NIX, and Job Smallpiece.

Mr. HINDMARCH opened the pleadings. They set forth that the plaintiff was the inventor and patentee of an improved mode of purifying gas, and that his patent had been infringed by the defendants. He therefore claimed, in addition to damages for such infringement, an injunction against the further use of his invention; and also that, in reference to the past, an account might be taken. The defendants pleaded, first, "not guilty;" second, that the plaintiff was not the first inventor of the process; third, that the invention was not a new invention; fourth, that no proper specification of the plaintiff's patent had been filed; fifth, that the invention was not the subject matter of a patent; sixth, that the invention which was specified was different from that for which the patent was obtained; and, lastly, that the disclaimer was not within the limits of the Act of Parliament.

The ATTORNEY-GENERAL: May it please your lordship,—Gentlemen of the jury, I have the honour to appear before you in this case as counsel for Mr. Hills, who seeks by your verdict to establish his claim to a patent which he took out in the year 1849, for what I venture at once to describe to you as one of the most useful and beneficial inventions known in this country, to which I think many people owe the preservation of their health—perhaps of their lives, and which entitles Mr. Hills to the commendation and gratitude of his fellow-countrymen. Gentlemen, I trust that when the few observations (for they shall be as few and as simple as, consistent with the performance of my duty, I can make them)—I say I trust that when the few observations which I shall have to address to you have been made, I shall satisfy you, having explained the nature of this invention, that it is entirely new, that it is of a highly beneficial character, that Mr. Hills, the patentee, is the sole and undoubted author of this invention, and that the present defence originates in the desire, certainly not to be commended, and I am afraid I may say, with a few honourable exceptions, in the combination of a few of the principal gaslight companies in and about the metropolis to deprive this gentleman of the benefit of his invention. Gentlemen, you are probably somewhat acquainted with the nature of the manufacture of coal gas, which has now become in all great towns, and especially in the metropolis, where this invention has been brought into effective use, an article of almost universal necessity. The manufacture of gas consists—after the gas is produced from the coal—of the mere operation, or rather of a series of operations, of purifying it from those ingredients which are combined with the product of the coal, and so bringing it into a state in which it is fit for practical use. First, as you are aware, it is passed through water (for I will not stop to describe minutely all the processes, but merely endeavour to make it intelligible to you so that you may have the character and effect of this invention prominently and distinctly brought before you)—first, it is passed through water, by means of which it is deprived of the ammonia which the gas contains as it emanates from the coal. But then there is another ingredient with which this gas is essentially and largely combined, and which it is absolutely necessary to set free, so that the gas in a pure state may at last be conveyed through the different vessels and pipes for the general use and benefit of the public, and that ingredient is sulphuretted hydrogen. The gas after passing through the water, being more or less purified of its ammonia, still holds in combination with it a considerable quantity of sulphuretted hydrogen; and it is utterly unfit for use, indeed it is impossible to use it without danger to the health, if not the lives, of any one within its reach, unless the sulphuretted hydrogen shall be absorbed and taken out of it. Accordingly, from the beginning of its manufacture, and ever since the use of gas in the metropolis, various means have been resorted to to absorb and take from it the sulphuretted hydrogen with which it is combined. Down to a very recent period—that is, down to 1849, when Mr. Hills, fortunately for himself and for others, discovered the mode to which I shall shortly have to call your attention—the principal means adopted for the purifying of gas was to pass it through a quantity of lime either wet or dry, and the lime having an affinity for sulphur deprived the gas of the sulphuretted hydrogen which became combined with the lime through which it passed. But, gentlemen, the necessary and inevitable effect of the use of this article, lime, for that purpose was, that when it had performed its office and become saturated with the sulphuretted hydrogen, it had to be removed and its place supplied with a new quantity to purify the next succeeding quantity of gas and the residue or the residuum—the lime in combination with the sulphuret taken from the gas had to be removed and disposed of in some way or other, and it was necessary to carry it off and deposit it in large quantities upon the premises of the gas manufacturer until it could be finally, in some way or other, carted away. Now, whether wet or dry lime is used for this purpose, when it becomes saturated with the sulphuretted hydrogen, and deposited anywhere in contact with the atmosphere, the effect is such as to render the spot almost intolerable to all who may be round it or upon it. The vapour from it poisons the whole atmosphere, and it is quite impossible, consistently with the health or comfort of those engaged in the manufacture, to allow it to remain for any length of time upon the premises. Accordingly, it must be carried away, and here a new nuisance arises. If wet lime is used and carried off in a liquid state, it assumes the form well known to those connected with manufactures of this kind of "blue billy," a deleterious and detestable kind of fluid which has to be got rid of in the shortest way possible. Formerly it was carried into the Thames, until it created a nuisance more intolerable than any we have heard of of late; it was also declared to be illegal, and so that method of disposing of it became impracticable. On the other hand, if the lime was in a dry state it had to be carted away; and as it passed along the streets it was almost a living nuisance, and wherever it was deposited it gave out most pestiferous exhalations. So that, whatever was the mode resorted to, the disposal of this residuum of lime saturated with sulphuretted hydrogen became an intolerable nuisance, and this was the great evil arising out of the manufacture of gas, until about the year 1849, when Mr. Hills, as he believes, as most of the gas companies have now ascertained, and as I hope to prove before you to your entire satisfaction, discovered a complete, effective, and perfect remedy for this nuisance. Gentlemen, Mr. Hills is a practical operative chemist of great experience, has been much connected with gas-works and the manufacture of gas, and in the course of the year 1849 he had gone through a great variety of experiments, and had directed his attention with great earnestness and great assiduity to the entire subject, till at length he found out a substitute for either wet or dry lime. He used the substance properly described as hydrated oxide of iron, mixed with sawdust or any other porous material, and allowed the gas, after being wholly or partially purified of the ammonia, to pass through this combined substance; and he found that such was the affinity of the oxide of iron in its hydrated state for the sulphuretted hydrogen contained in the gas, that the latter passed forth completely purified, the whole of the sulphuretted hydrogen being absorbed and taken away. And then, further, by a succession of experiments, he discovered that whereas this substance—the hydrated oxide of iron and sawdust—would, in due time, after the passage through it of very large quantities of gas, perhaps during several days or a week, or even a month, become entirely saturated with sulphuretted hydrogen, in which state it would have, supposing it to be a mere substitute for lime, to be carted away and disposed of in some way or other—I say he discovered that by the very simple process of exposing the oxide of iron and sawdust, saturated as it was with the sulphuretted hydrogen, of which it had deprived the gas, to a current of mere atmospheric air, the oxygen of the air would combine with the sulphuretted hydrogen, the sulphuretted hydrogen was entirely carried off, and the mass thus completely purified and renovated might be again put into the proper vessels and used over and over again, perhaps twenty or twenty-five times, performing the same office of effectively and perfectly purifying the gas. The invention of Mr. Hills is the combination of substances which would result in the mixture of hydrated oxide of iron with sawdust, and then when the gas has passed through this substance and left the sulphuretted hydrogen belonging to it until that ingredient has completely saturated the mass, it is a further part of his invention that it should be exposed to the atmospheric air by being removed and spread out openly, or by letting in a current of atmospheric air, so that it is completely renovated and can go through the same office over and over again until it becomes useless. So that whereas, under the old process of manufacture, this intolerable nuisance which I have described was invariably and inevitably produced and made to follow the purification of gas, Mr. Hills' process is entirely free not merely from this great evil and nuisance, but free from any description of inconvenience whatever. The article that I have mentioned is taken out, exposed to the atmospheric air, purified, renovated, does its office over and over again; and when at last having been made the instrument of this process for a great number of times, it may be carted away and disposed of (though I will not stop to trouble you with an account of that) and turned to a further useful purpose. It is entirely free from any unpleasant smell; and thus the whole system of the purification of gas may be gone through by this invention of Mr. Hills without danger to life or health, and without inconvenience to any one engaged in the operation. This, gentlemen, is the invention for which, in the month of November, 1849, Mr. Hills took out the patent, the validity of which is now to be tried before you, and which patent your verdict will either set aside or completely, and, I hope, finally, establish. This is the invention, and it is this that I have to satisfy you was new, was his invention, and is of the beneficial character that I have described. Now, gentlemen, in this, as in all other cases of patents of which I have had any experience, we are met with every description of objection that can be put upon the record; every possible ground is stated upon which the validity of the patent may be impeached; and you will be told by my learned friend, Mr. Bovill, that it is not new, that the discovery was made before, that other people had the merit of this discovery, that Mr. Hills had learnt the process from some one else, and that he claims the merit of an invention which does not belong to him. In fact, you will have to consider upon the whole of the evidence which will be laid before you, on the one side and on the other, whether Mr. Hills speaks the truth; as he will come forward in person and describe the invention of which he claims to be the author, and declare to you also, upon his oath, that he is the sole author of the invention—I say you will then have to determine whether he speaks the truth or not. Now, gentlemen, I should not, I think, well discharge my duty towards you if I were at once to sit down and leave it to my learned friend to bring forward the objections which he may have to offer to the validity of this patent, because I ought at once to state to you

that this action has been tried before in the Court of Exchequer, in London, and we know, in consequence, what the nature of the defence will be. I think, therefore, I shall, instead of unnecessarily occupying, perhaps be saving time in the end, by entering a little—and it shall be but little—into what I anticipate will be the defence to this action. In the first place, we have in this case, as is usual, a notice given of every patent which has ever been taken out since the beginning of time in relation to the manufacture of gas, and which patent is said to contain the invention of which Mr. Hills claims to be the author. But I think, gentlemen, it will be found generally, from the experience we have had in the past and upon former trials of this case, that there is one patent, and only one upon which anything like serious reliance will be placed by my learned friend, and upon that I have something to say to you. Perhaps, however, before I allude to that patent, I may, for the information of his lordship, read to you the material parts of the specification of Mr. Hills' patent, as it will then become apparent what is really the essence and true merit of this invention, which I shall beg of his lordship and you to bear in mind is the use of the hydrated oxide of iron. The oxide of iron is of two kinds—the simple oxide of iron, which is uncombined with water, and the hydrated, which is combined with water, which contains a quantity of hydrogen within it, and which has a most potent and material effect upon the sulphur to be taken from the gas which has to be purified. You will bear in mind this distinction, because, before I read the very few sentences in the specification which it is material to read in order to make the case intelligible, and before I refer to Laming's patent or any other patent, I beg you to remember that what is alleged is, that, until this invention was made the subject of a patent and became known to the world in general and to the manufacturers of gas throughout the metropolis (and I now at once challenge my learned friend to show the contrary), hydrated oxide of iron was never used for the purification of gas. I deny that until this patent, which clearly explains its use, was published to the world in 1850 it was ever employed for that purpose—I mean substantially speaking, because you may talk of experiments—partial experiments being made and never afterwards heard of—but I say that until the specification of this patent was published in 1850 the purification of gas was never practically effected by means of hydrated oxide of iron, and I rest the case upon that assertion. This is the specification, and I would just state, in order to explain to my lord why a portion has been taken out, that the patent was first obtained for the compression of peat; but that is perfectly immaterial, because it has since been entirely disclaimed. It now remains as a patent for an improved mode for the purification of gas, the specification being altered, so that it now begins at page 9. At page 12, immediately after the part struck out, the specification proceeds thus:—"My improvements in the purification of gas consist of a method of purifying it from sulphuretted hydrogen, cyanogen, and ammonia, by passing it through the following porous material, and of renovating the material employed after it has become inert. I effect this in the following manner:—I take the subsulphates, the oxychlorides, or the hydrated or precipitated oxides of iron (which I prefer to use in a rather damp state), either by themselves or mixed with sulphate of lime, a sulphate or muriate of magnesia, baryta, strontia, potash, or soda." And he says, "I absorb them into, or mix them with sawdust or peat charcoal in coarse powder, or breeze, or other porous or absorbent material, so as to make a very porous substance easily permeable by the gas." Gentlemen, the patentee has stated, as he is bound to do, if such be the truth (and it is convenient for the public that he should so state), not only what, in his own estimation and as the result of experience, may prove the best, but there are several ingredients, each or either of which may suffice for the purpose, so that people may take that which is most easily to be procured, or which they may think most likely to succeed in their particular circumstances. But the substantial part to which I call your attention is that in which he says, "I take the hydrated or precipitated oxides of iron," which he thought, mixed with sawdust, was the best of these combinations, and of which he says, "This material is to be put into a purifier (such a one as is used for dry lime answers the purpose), and the gas is to be passed through it; whereby the gas will be deprived of its sulphuretted hydrogen, cyanogen, and a part of its ammonia, which will be absorbed into the porous material, water being at the same time formed by the union of the oxygen of the oxide and the hydrogen of the sulphuretted hydrogen absorbed." That, then, describes the process; and this substance being procured, it is placed upon layers—one, two, or three layers—within a vessel through which the gas is made to pass; and in its course it is purified of the sulphuretted hydrogen, which becomes absorbed in the hydrated oxide of iron and sawdust. The substance having thus performed its office, is to be renovated in the way next stated:—"As soon as the material ceases to purify the gas from sulphuretted hydrogen, the gas is to be shut off from the purifier, and a communication is to be opened to the external air, which is to be admitted to the purifying material, and by the agency of which it will be renovated, and the uncombined gases which have been absorbed will be driven off. The best way to effect this is partially to take off the atmospheric pressure at the top or bottom of the purifier in which the purifying material is contained, by connecting it with a pipe to a hot and powerful chimney, or to an exhausting apparatus, so as to cause a current of air from the opening in the purifier communicating with the external air to pass through the purifying material. The current of air will drive off the volatile gases which have been absorbed into the purifying material from the gas, but which have not united with the purifying material, consisting principally of ammonia and of some sulphuretted and carburetted hydrogen. The air will at the same time re-oxidize the iron of the sulphuret of iron which has been formed, and sulphur will be precipitated, and a small but variable quantity of sulphuric acid will be formed." Then he says: "As soon as the iron is re-oxidized, which generally will be the case in a few hours, the gas is to be passed through it again, when the same effect will take place as at first, and this process of purification and re-oxidization or renovation of the purifying material is to be repeated until the purifying material ceases to be efficacious." Now, gentlemen, that substantially is the twofold process which I have described to you. [The learned counsel explained, by reference to a drawing, the description of vessel in which the purification is effected, and exhibited a specimen of hydrated oxide which he denominated iron-rust combined with water.] The natural colour of this substance is red, but when it becomes saturated with the sulphur it acquires a dark or black appearance. When the gas has passed through these layers of oxide in such quantities that the oxide is completely saturated with the sulphuretted hydrogen, it is taken out and exposed to atmospheric air in the way I have mentioned, and by that means the sulphur is got rid of, it is reconverted into a pure oxide as before, and the process of the purification of gas may be repeated with it until it becomes unusable, and is obliged to be carried away. We have now only to consider, and I will do it in as few words as possible, what it is the defendants have set up, or propose to set up, by way of defence in order to deprive the plaintiff of the pecuniary profit and advantage to which, if ever man was, he is fairly and justly entitled as a remuneration for the skill, labour, and time which he has bestowed upon this invention. Gentlemen, it is chiefly, as I told you before, a patent, or supposed patent of a person of the name of Laming, which was used on a former occasion, and which I presume will be relied on again. I must say at the outset, that it is rather extraordinary that Mr. Laming should be the individual through the medium of whom this patent is now to be assailed as not being a new invention, and not the invention of Mr. Hills. Mr. Laming had certainly taken out a patent in 1847, and you will hear by-and-bye what that patent is; but from 1847 to 1850 I will defy my learned friend to prove that Mr. Laming, or any one else, ever used hydrated oxide of iron as a means, and an effectual means, of purifying gas during the process of manufacture. But in the year 1850, after Mr. Hills' patent and specification had been published (of course you know a patentee is bound to make his patent public by means of a specification which is known to all the world), Mr. Laming, in conjunction with a gentleman named Evans, took out a patent for the purification of gas. But when they went before the law officer of the Crown—a process which is necessary before any patent is taken out—it appeared, upon the opposition of Mr. Hills, that they were actually endeavouring to procure a patent for that which he had obtained a patent in 1849, and the then Attorney-General, Sir John Romilly, at once struck out that portion of the patent which related to the purification of gas, and thus, on the part of the Crown, refused the grant of any patent for that which had before been patented by Mr. Hills. Notwithstanding that, these gentlemen, I must say in the most unwarrantable and, as far as my experience goes, unprecedented manner, introduced into their specification (of course in other language, but substantially) a claim to the very invention of which they knew that Mr. Hills was the author, and their right to which Mr. Hills had successfully opposed and defeated before the Attorney-General. In this patent of 1850 which was taken out by Laming, they introduced, in defiance of the refusal of the Attorney-General, the claim to, and proposed to manufacture, the article and to take the profits which alone belonged to Mr. Hills; and, in consequence, in the year 1852 Mr. Hills instituted proceedings, by way of *scire facias*, against Laming and Evans—a mode in which, if a patent is void, or contrary to law in any way, it is to be set aside. Before, however, the matter could come on for trial these two gentlemen, who probably were well advised, found that they could not maintain this claim, and they applied to the then Attorney-General, Sir Frederick Thesiger, now Lord Chancellor, to be allowed to disclaim so much of their patent as was objected to by Mr. Hills. That learned person, on this occasion, very promptly and decidedly refused to allow them to disclaim, and as they would not venture to go to trial, they suffered judgment to go by default, and the patent was abandoned. It would be rather curious if, after this, we should have Mr. Laming, or any witness, come forward to prove that he was the inventor, when he could not before Sir John Romilly in 1850, or before Sir F. Thesiger in 1852, or before a judge and jury—if he had thought fit to proceed on the *scire facias*—substantiate his claim; and I think, at this distance of time and under the circumstances which will come before you, he will hardly now succeed in defeating Mr. Hills' patent on this ground, or on the ground that he (Mr. Laming) had in 1847 taken out a patent for improvements in the manufacture of gas, which patent was said to contain this invention, and so be fatal to Mr. Hills' claim. But this matter did not stop here, for in 1852, these proceedings having been taken, the parties came together, and very properly, as I think, entered into an arrangement by deed, which, if it becomes necessary in the course of these proceedings, I can produce to you. I merely now state the fact that an arrangement was then made, which was this—Mr. Hills insisted, as he has ever done since 1849, and as he insists before you now, that he was the sole inventor of the mode of applying this substance, the hydrated peroxide of iron; and he was, and is, quite willing to give up to any one else the benefit of any process by anhydrous oxide—that is, oxide uncombined with water; and the arrangement entered into was this—that, for the manufacture, and sale, and use of the hydrated oxide, Mr. Hills should be deemed the patentee, and that whatever was done in respect of that article should be done under licence from him, and for which he was to receive a royalty; and he was content to take a licence from Mr. Laming and two gentlemen with whom he was then in partnership, Mr. Owen and Mr. Mertens, in respect to the use by anhydrous oxides. I may mention to you that from that time to about the beginning of 1856, the hydrated oxide of iron was in constant use in several large gas companies in the metropolis and in many other places, and that it has been successfully used by licence granted under the patent now in question. Mr. Laming acted under it, and Mr. Evans acted under it, and paid him the fair meed of praise and profit to which he was entitled. Some of the companies have continued to do it to this day, and many others continued to do it, until circumstances arose to which I have to call your attention; while, on the other hand, Mr. Hills found it utterly useless to attempt to purify gas, or to go through any process in reference to the manufacture of gas with the anhydrous oxide—in fact, that it was totally useless. Gentlemen, I will now refer for a moment to the specification of Mr. Laming, without going through any other of the objections to this patent, because it has been the subject of very great misunderstanding, and the plaintiff was in his first cause nonsuited on account of it. Mr. Laming no doubt had, as all chemists have had for a century past or more, a general knowledge of the fact that oxide of iron has an affinity for sulphur, but what particular kind of oxide—whether hydrated or anhydrous, and whether in combination with other substances or without—you will find it is perfectly clear, from his specification of 1847, he had no idea whatever; and I say again, that until the publication of the patent of Mr. Hills in 1850—as far, at least, as we know—no human being ever knew the powerful and effective properties and qualities of this hydrated oxide of iron for the purpose named. But what Mr. Laming did know was this—that sulphur might be taken out of gas, and that gas was purified of sulphur by some ingredient or other of which oxide of iron formed a part; and you will find, accordingly, that by his specification he recommends a combination of chloride of calcium and any one of a number of metallic oxides; and also claims the use of carbonate of iron for that purpose. It was supposed at the trial, under a misapprehension, that the carbonate of iron described by him was the hydrated oxide of iron sometimes sold in the druggists' shops as carbonate of iron; Mr. Laming was said, therefore, to be the discoverer of this article, and the plaintiff accordingly failed. But you will find, gentlemen, that this is entirely a mistake; carbonate of iron is carbonic acid and iron in combination, but hydrated oxide has no carbonic acid in it at all. Carbonates will not purify; hydrated oxide will purify; and it is a total misapplication of terms to suppose that the carbonate of iron described in Laming's specification is the hydrated oxide of iron which is the subject of this patent. Mr. Laming in his patent says, "Chloride of calcium is both abundant and cheap, and under certain circumstances it may be desirable to make it for the purpose of gas-purifying by means of lime or chalk; and in such cases the oxides or carbonates which result are useful for purification, and need not be removed." So that you see he says that chloride of calcium and any of these oxides, which he calls carbonates, and not pure oxides, will answer the purpose. All I can say is, that this is an entirely different substance to that which Mr. Hills has patented, and which completely effects the desired ob-

ject, while that here described by Mr. Laming is found to be totally useless. Then he goes on to say, "I do not claim any of these processes, but I claim the application of mixtures so made to the purification of coal gas." Again, he says, "Another part of my invention consists in the use of the carbonates of manganese, iron, zinc, and lead for the purification of coal gas, for which purpose I damp them, and dispose them, mixed or unmixed with sawdust, or other matters, in the course of the gas, as is practised with the hydrate of lime; or I mix them with the purifying matters which I have claimed as my invention, or with other purifying matters hitherto in use for a similar purpose, in a state of mechanical division. To obtain these carbonates in an economical manner, I throw down from ammoniacal or gas liquor obtained in making coal gas, and previously distilled or not, the sulphur which it contains, and, having drawn off the clear liquid, I next precipitate its carbonic acid; or, instead of making two separate precipitates, I throw down a mixed sulphuret and carbonate of the precipitant or precipitants. I prefer to precipitate by means of a muriate or sulphate of manganese, iron, zinc, or lead. I do not claim either of these ways of obtaining a metallic carbonate, but I claim the use of the carbonates above named, however obtained, for the purification of coal gas." Here he uses carbonate of iron, and the question is whether he, having pointed out carbonate of iron as one of the means by which gas may be purified, has pointed out that which we claim as the invention of Mr. Hills. The answer is threefold. In the first place, carbonate of iron is not hydrated oxide; it is iron in combination with carbonic acid, while hydrated oxide has no carbonic acid in it at all. If it had, it would not purify gas; and therefore upon what principle, because a man tells you that carbonate of iron will purify gas, he is to deprive another of a patent for hydrated oxide, which is not a carbonate, and which, if it were, we contend would not purify gas, I cannot well discover. But then it was supposed that, if you went into a druggist's shop and asked for carbonate of iron, the article sold to you as such was not carbonate of iron strictly so called, but the very hydrated oxide spoken of in this patent. That was imagined to be the case from some evidence which was unguardedly given, and, if I may presume to say so, unguardedly received on the part of the court before which this case was tried. But, in reality, that is not the fact; the fact is, that which is sold as carbonate of iron is oxide of iron combined with carbonic acid; but it so happens that if you take a small portion of this article, and expose it to the atmosphere, the effect will be to cause it to throw off the carbonic acid, and to cause the hydrogen in the atmosphere to combine with the oxide of iron, and form hydrated oxide. But the article sold in the shops is carbonic acid combined with anhydrous oxide, and it is only by the exposure of small portions to the atmosphere in the way I have stated that it can ever become hydrated oxide. Gentlemen, the absurdity of supposing that the article patented by Hills is carbonate of iron, and is the article sold in the druggists' shops as such, is this, that the latter article is some £60 per ton, and however good it might be as a purifier, it would be practically useless; but the cost of this article of Hills is so small that it is as cheap as lime, attended as that is with all the evils which I have described to you. But, to come back to the point, carbonate of iron is, as I have stated, an anhydrous oxide combined with carbonic acid, which can only become hydrated by a process not dreamt of or alluded to in the specification of Mr. Laming, and could only be a mere matter of accident—viz., the exposure of small portions to the surface of the atmosphere. But if reliance should be placed upon this specification of Laming, of 1847, you will find throughout the whole of its language that what he means by carbonate of iron is carbonate of iron properly so called, and is not hydrated oxide, of which he had no idea at all. He says, "To obtain these carbonates in an economical manner, I throw down from ammoniacal or gas liquor obtained in making coal gas, and previously distilled or not, the sulphur which it contains, and, having drawn off the clear liquid, I next precipitate its carbonic acid; or, instead of making two separate precipitates, I throw down a mixed sulphuret or carbonate of the precipitant or precipitants;" so that he expressly makes carbonic acid to be an ingredient in his carbonate of iron, and shows it to be so in its true chemical and philosophical sense. He then goes on to say, "I do not claim either of these ways of obtaining a metallic carbonate, but I claim the use of the carbonates—(not oxides, but carbonates)—above mentioned, however obtained for the purification of coal gas." Then we find further on he says, "Another part of my invention consists in increasing the purifying powers of the aforesaid preparation of chloride of calcium, or chloride of calcium and metallic oxide, or chloride of calcium and metallic carbonate, and also of the aforesaid metallic salts absorbed in solution into sawdust, by adding thereto oxide of manganese, iron, zinc, or lead, obtained in a proper state from any other economical source;" and, finally, line 31, page 6, he expressly disclaims the invention, or application for this purpose, of any metallic oxides whatever, because he says, "I do not claim the exclusive use of any metallic oxide for purifying coal gas, but what I do claim is the combination for that purpose of the oxide of iron with the other purifying matters above indicated; whereby the gas may be perfectly purified from its ammonia and its hydro-sulphuric acid without requiring a succession of purifying vessels;" so that where he uses carbonate of iron, he means carbonate of iron, and when he comes to specify what his claims are, he expresly disclaims the invention or application of any metallic oxides in combination with chloride of calcium or anything else. Gentlemen, I am very sorry to have occupied so much of your time with these scientific and technical matters, but, as this was the patent which for the day was fatal to the claim of invention on the part of Mr. Hills, I thought it right that I should possess his lordship and yourselves as clearly as I am able, and as amply as the case requires, with the real nature of the question to be tried in relation to these two patents. Having said this, I pass to the remainder of the case, which I shall touch upon in a few words, for, though there are a large number of objections, I believe I have referred to the principal one, and I hope in the result it will be made as clear to you, as I presume to say it now has become clear to myself, that the invention of the hydrated oxide of iron and the application of it to the purification of gas is the invention of Mr. Hills, and of him alone; and that to that invention he has added what it is not pretended to be claimed for this gentleman, Mr. Laming—viz., the essential improvement of the frequent renovation of the article employed by the mere exposure of it to atmospheric air, a mighty improvement in the economy of this manufacture; and whatever improvements may have been invented, whether meritorious or otherwise, by any other person, is something totally distinct to that which he now claims. Now, gentlemen, we have a long list of objections. We are told, first, that the plaintiff is not the inventor, and it is intimated that a gentleman who will appear before us, a Mr. Evans, is the inventor; that he communicated it to Mr. Hills, or that Mr. Hills, somehow or other, learnt it from him. I shall at the very outset of the case put Mr. Hills in the box, and he will there be exposed to the cross-examination of Mr. Bovill; and if he can make out that Mr. Evans is the inventor, of course that gentleman will have the benefit of the invention, and my client will retire from the court discredited and deprived of that which he now claims to be entitled to. But I can only say that if Mr. Evans did invent this and communicate it to Mr. Hills in 1849, it is rather singular that he should have come forward and claimed it as a new invention in 1850, as he did by taking steps to obtain a patent. Again, it is rather singular, if he claims to be the inventor, that he and Laming should set up the case that Laming was the inventor three years previously, viz., in 1847. However, I will leave that to my learned friend, and will not anticipate the case further; but I say with undoubted confidence, that I will defy my learned friend to prove that any one ever heard of this invention of hydrated oxide until Hills' patent was obtained in 1849. Do you think, if it had been so, that Laming and all the rest of them—these very companies who are now combining to ruin Mr. Hills—would for years together have used this article to an immense extent, over and over again, under licences from him, those licences being granted under this very patent? Then we are told that the invention is not new, and we have notice of an invention by a person of the name of Croll, in addition to that of Mr. Laming and others by Johnson, Phillips, and a host of others. I mention these, but I will not go into the details as I have with the one which I believe to have been the chief source of objection at the last trial. I will leave it to my learned friend to deal with Croll's, and with Phillips's and with Johnson's, and with the variety of scientific works in which it is said the discovery appears; but what I venture to predict to you is this, that you may find it was perfectly well known that some of these substances had what is called a chemical affinity for other substances, and the idea may have entered into their heads that in some mode of combination or other this method of purification might be effected, but as to any person having discovered hydrated peroxide of iron and applied it to this purpose, especially with the mode of renovation by exposure to atmospheric air, it will not be found in any of those scientific works or patents. We have also another plea put upon the record—viz., that the specification is not sufficient (but I suppose that my learned friend will not rely upon it)—that is to say, it does not state sufficiently clear the method of operation so that any competent workmen can use it without difficulty. Then, too, we have the old objection that this is not the subject of a patent; but that is purely a question of law, and, if raised at all, it will be for my lord to deal with, and therefore I shall not say a word about it. We are told further that the invention in the specification is not the invention for which Mr. Hills took out his patent. I tell you at once what I understand that to be: it appears to be this. In 1849, when Mr. Hills took out his patent, it was a practice which is known no longer, we having adopted a better system—but it was then the practice of the law officers, to whom every patent was submitted, instead of looking merely to the title of the invention, to demand a note in writing, stating shortly and in outline what the nature of the invention was, and, accordingly, people were in the habit in those days of giving in a single sentence or two, generally prepared by their agent, for the consideration of the law officer. When Mr. Hills went to take out his patent in 1849, he knew nothing of this process—whether or not his agent had not apprised him of the necessity for it, I am not aware—but, when he went to the Attorney-General's chambers to receive his patent, he was told, "You have not given in a note of the nature of your invention." He did not know what was meant, and it was explained to him as well as possible. "What am I to do?" he said. "You must sit down, and write it here;" and they gave him the back of a letter belonging to the Attorney-General, who was waiting for the note. He wrote hastily and nervously, as a man would do under the circumstances; and now it is said that he did not specify of what he was the author. Gentlemen, in that deposit-paper he says that his invention is—First, for compressing peat between inclined planes and rollers, with absorbent substances interposed. Second, for carbonizing coals, &c., &c., in retorts and furnaces, by passing atmospheric air through the fuel therein contained, and, when sufficiently hot, introducing the charge of coals, &c., to be carbonized; which coal, &c., should be previously heated, and then excluding the air; also by passing highly-heated gases through it in the retorts or furnaces. Third, for obtaining alumina, or alum, from aluminous shale, for purifying gas, or other purposes, by causing sulphuric acid to pass through it. Fourth, for arrangements of pipes, &c., for distributing liquids in gas purifiers. Fifth, for absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again either by heat or by taking off the pressure of the atmosphere. Sixth, for heating the coal, &c., to be carbonized before putting them into the retorts or furnaces. The fifth of these is the one specially referred to, and he thought he had said enough upon it, for that is really the object of his invention. Gentlemen, it is new to me, if he had ever so misdescribed his invention in the hurry of the moment, that that in the courts of law would have affected his patent. But this would have affected it—if that document should prove to your entire satisfaction that, at the time he wrote it, he had not invented the substance, and that, when he took out his patent, he was not the author of the invention, that would be a defence in point of law. But Mr. Hills will state the circumstances under which he wrote that paper while keeping the Attorney-General waiting, and I am sure you will see no reason to doubt the truth of what he says, because he will be supported by every fact and circumstance which surrounds it, and he will tell you that he had perfected his invention when he made this statement. Gentlemen, I think I have now gone through the whole of this matter, and will sit down. I have told you the nature of the invention; I have told you the benefit of it; I have alluded, as far as it is necessary or just, to the answers which I believe will be offered to this action; and I shall now sit down, calling, in the first place, Mr. Hills himself before you, and then submitting the whole of the evidence in this case, the result of which I sincerely trust and confidently hope will be that this gentleman will find by your verdict that his patent is completely and finally established, and that he has defeated the combination formed against him, which I cannot think is fair or creditable on the part of those who seek to deprive a meritorious man of the benefit to which he is justly entitled for a very meritorious invention.

Mr. *Frank Clarke Hills*, examined by Mr. M. CHAMBERS.

I am the plaintiff in this cause, and am a manufacturing chemist having works at Deptford and East Greenwich. In the course of my business as a manufacturing chemist my attention has necessarily been drawn a great deal to the manufacture of gas. My premises at Deptford adjoin the Deptford Gas-Works for twenty yards. I am very well acquainted with the process of manufacturing coal gas for the purpose of illumination. The first condition of it is to put coals into what are called retorts; the retorts are first made red hot, and the coals are then introduced, by which process the gas is distilled from them. The gas passes from the retorts in a very impure state, being mixed with sulphuric acid, carbonic acid, and ammonia. In order to get rid of the ammonia it is passed into what is called a washing vessel or scrubber, in which water is present which condenses the ammonia, and deprives the gas of it. Generally speaking, nothing but water is used for that purpose, but sometimes acids have been employed. When the gas has passed through the scrubbers it still retains a large quantity of sulphuretted hydrogen, in order to get rid of which it used to be passed through dry or wet lime purifiers. In the dry-lime purifiers the lime was strewed upon sieves or gratings, and the gas permeated through, leaving its sulphuretted hydrogen in the lime, and when thus purified the gas was passed on for consumption. In the wet-lime purifiers the lime was put into a kind of vessel or tub, and water was put to it, making it into a kind of cream. The gas was then passed into it, and the

sulphuretted hydrogen removed in that way. The lime could never be used more than once before it became fully charged with sulphuretted hydrogen. It was then removed into heaps, and gave rise to great inconvenience and nuisance. The action of the atmosphere upon the lime charged with carbonic acid is to form carbonate of lime, and to create a great nuisance. The sulphuretted hydrogen is liberated, and mixes with the air, causing a very noxious smell like rotten eggs, and very injurious to health.

Mr. CHAMBERS: Was that sufficient to cause complaints to be made against the gas companies?

Baron BRAMWELL: I think we may take it that it was a great nuisance, or at least a thing which it was desirable to obviate.

Witness: It was. In reference to the wet-lime process, there were various methods of getting rid of the refuse. I have seen it spread over the gas-yards in ponds or puddles, and it was sometimes run off into the river or the sewers. It was this product which, on account of its colour, acquired the name of "blue billy." The previous process of passing the gas through water did not entirely remove the ammonia; there was generally a little left, and sometimes a great deal. A portion of this was condensed in the lime, but there would still be some ammonia remaining when it had passed through for consumption. That was a disadvantage; and in order to make the manufacture perfect, the object would be to get rid of all the sulphuretted hydrogen and ammonia before distributing the gas for the purpose of illumination. I was fully aware of the disadvantages of using the system of lime purification, and as early as 1848 I began my experiments to effect a remedy for the evils which it occasioned. Previously to that, I had directed my attention to the best means of getting rid of the ammonia. One plan which I adopted was to pass the gas through wet sawdust in a vessel called a scrubber. The scrubber was filled with sawdust, water was put in at the top and allowed to percolate through, meeting the gas as it ascended, and, water having a great affinity for ammonia, it became absorbed.

Mr. CHAMBERS: Now, in the year 1848, you mentioned that you made some experiments—will you be so good as to describe what your experiments really were, with reference to the purification of gas from sulphuretted hydrogen?

Witness: With regard to oxide of iron, I thought that the oxide would take away the sulphuretted hydrogen. I tried a great number of experiments in order to ascertain what sort would do best, and I found that the hydrated was the only one that would succeed.

Mr. CHAMBERS: Allow me to ask you whence you derived your opinion that some oxides would accomplish the object—how you came to entertain that opinion?

Witness: I knew, as a chemical fact, that iron had an affinity for sulphur, and I had used salts of iron before, which I found took up sulphuretted hydrogen, and it occurred to me that the oxides would do better; I therefore tried experiments with them. Salts of iron is a combination of iron with an acid; sulphuretted hydrogen is a combination of sulphuric acid and hydrogen. There is such a thing as native oxide of iron, but that is a stone; it is one of the iron ores taken up from mines for the purpose of making iron. Hydrated oxide has water combined with it; anhydrous oxide has none. I tried various oxides until I found that the hydrated was the proper one. I sent two or three samples of the hydrated oxide into the adjoining gas-works to have them tried. I sent in a purifying vessel charged, as at that time they had no dry-lime purifier up. At the latter end of 1848 they put up dry-lime purifiers. The oxide of iron which I sent in answered the purpose: it purified the gas, and when it became black they returned it to the yard in that state. The oxide of iron in its natural state is of a reddish brown colour. [Sample of hydrated oxide mixed with sawdust produced.] It is the rust of iron. The rust of iron is always an oxide, but not always hydrated. The experiment then made satisfied me of the fact that hydrated oxide would produce the effect of purifying gas from sulphuretted hydrogen, but I did not afterwards use that same material again, as it was inconvenient for them to try it. If you could use the oxide of iron only once before it became fully charged with sulphuretted hydrogen, it would not answer commercially, as far as expense is concerned. It would cost as much as the gas, and it would be perfectly inapplicable unless you could use it over and over again, as it would be too expensive. Such being the case, I gave my attention to discover whether the hydrated oxide might be used over again; and in 1849 I renovated it eight times after being used in experimental purifiers with gas which the company laid on. Those purifiers were made of glass, in order that we might see the result, and the gas was supplied in an impure state from the hydraulic main, without the ammonia or anything else having been removed, so that I went through the entire process of purification. I had purifiers or scrubbers on a small scale for getting rid of the ammonia. They were earthenware jars, and the material employed was sawdust and water. The purifiers employed for the removal of the sulphuretted hydrogen were long tubes of glass, so that as the gas came in at the bottom I could see the effect produced. I found that the hydrated oxide answered the purpose, and the next step was to revive that material after it had been used. I found by repeated experiments that by passing air through it in the purifier, or by spreading it out so that the air could come in contact with it, it became renovated, the black colour was lost, and it assumed its original brown, so that it was in a fit state to use again. This was occasioned by the oxygen of the air uniting with the iron and forming an oxide of iron, and the hydrogen of the sulphuretted hydrogen, uniting with the oxygen, forming water, the sulphur being precipitated in the mixture as free sulphur. The process throughout was free from any inconvenience or smell. I found that the oxide so renovated would purify the gas again and again, and that therefore, in reference to expense, it would answer the purpose commercially, being as cheap as the dry-lime process, a less quantity being required, and the removal of material being avoided.

Baron BRAMWELL: I do not think we need go into details, because I believe the utility is not in dispute.

Mr. BOVILL: No, my lord; it is not.

Examination resumed: I continued these experiments up to the period of my specification; I tried dozens and dozens of experiments. I recollect the time of applying for my patent. It was before then that I ascertained that this process was a successful one for the purification of gas. I continued my experiments after that time because it was requisite to do it in a great many ways to ascertain how often the material would do over again, and what were the best things to be mixed with it. I was also trying other kinds of oxides, and, as I had my own business to attend to, I could only give time to these experiments occasionally. The Rev. Mr. Dale, who is a very good chemist, visited my laboratory during that period, and had opportunities of seeing my experiments. When I went before the Attorney-General to obtain my patent, I was opposed; and having no written memorandum of what my invention was, I had to write one in the Attorney-General's chambers. I did not know beforehand that it would be required. The Attorney-General's clerk supplied me with the back of a letter for the purpose of preparing that memorandum, and also another piece of paper on which to make a copy. I believe there is a gentleman here who will prove that. [An admitted copy of the deposit-paper was handed in.] I wrote this memorandum in a great hurry, while the Attorney-General was waiting. There were several things for which I then proposed to take the patent, but this was the material one —"For absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again either by heat, &c., or by taking off the atmospheric pressure." The material I used did absorb sulphuretted hydrogen, as I have stated; and by removing the atmospheric pressure from the top of the purifier—by connecting it with a chimney—it causes a draft of air to pass through and renovates the material, the gases being evolved. This process is thus set forth in my patent:—"The best way to effect this is partially to take off the atmospheric pressure at the top or bottom of the purifier in which the purifying material is contained, by connecting it with a pipe to a hot and powerful chimney, or to an exhausting apparatus, so as to cause a current of air from the opening in the purifier, communicating with the external air, to pass through the purifying material." I relieve it from the superincumbent atmospheric pressure by carrying that off by heat, and the cold air comes in and renovates the material. A good deal of heat is evolved. I took out the patent as specified here. As soon as I had obtained my patent I applied to some of the companies to use my process, and a great deal of trouble I had to make them do so. I had an immensity of trouble; the companies being reluctant to adopt it or to recommend it, as in reference to those which used the wet-lime process it involved a necessary alteration of the purifiers altogether, and where the dry-lime process was in use, some engineers did not like to interfere as it involved a great deal of trouble. I did get it introduced to some of the companies, and now, with the exception of a few, almost all in London adopt the process. The Western Gaslight Company and the Surrey Consumers' Company do not use it. After my patent had been taken out, Messrs. Laming and Evans took out one. That was in 1850.

Mr. CHAMBERS: Before I touch upon that, I must ask you this general question—Before you took out your patent in 1849, were you aware, or are you now aware, of the hydrated oxide of iron ever having been used for the purpose of purifying gas?

Witness: Certainly not, sir.

Mr. CHAMBERS: Or were you aware, from any work or from any information given to you, of its having been recommended to be so used?

Witness: No. If you refer to Laming and Evans, I do not know whether they had made experiments.

Mr. CHAMBERS: No; never mind that. From any source whatever, before you took out your patent, were you aware of the hydrated oxide of iron ever being used for purifying gas?

Witness: I was not.

Mr. CHAMBERS: Are you now aware that the hydrated oxide of iron had ever been used, before you took out your patent, for the purification of gas?

Witness: In a certain mixture?

Mr. CHAMBERS: No, alone and independent?

Witness: Certainly not.

Mr. CHAMBERS: Or mixed with sawdust?

Witness: No.

Mr. CHAMBERS: In order that we may try the thing fairly, this leads me to the patent of 1847. Were you aware of the patent taken out by Laming in 1847?

Witness: I was.

Mr. CHAMBERS: In any part of that patent is there any statement that——

Mr. BOVILL objected to the form of question.

Mr. CHAMBERS: Did you derive from that patent any surmise, suggestion, or knowledge that hydrated oxide of iron could be used alone or in combination with sawdust for the purification of gas?

Witness: I did not learn anything of the sort. I do not think there is any hydrated oxide of iron to be found in that patent.

By Baron BRAMWELL: The sawdust is used merely to make the substance lighter; it is not an essential at all; it can be used without, but this makes it more porous, and thus facilitates the passage of the gas.

By Mr. CHAMBERS: You may use breeze or any other porous material for effecting the same object, or hydrated oxide of iron may be used alone if you damp it and supply it in granules. I prefer sawdust to the other things. Previously to taking out my patent, I had not, either by word of mouth or in any other way, received information with regard to any part of my process for the use and renovation of oxide of iron for the purification of gas. After some time, I complained of the patent of Messrs. Laming and Evans, and said that they were infringing my invention. I directed my solicitor to take proceedings against them, and the result was that their patent was repealed. I think I attended personally and opposed the grant of their patent. On that occasion, as far as my memory goes, I think they went in first to the Attorney-General, who heard what they had to say, and I went in afterwards, and upon my objections being made, the Attorney-General struck out certain passages of their deposit-paper.

Mr. BOVILL: You were not present?

Witness: I am not certain that I was.

Baron BRAMWELL: There can be no doubt about this, because the document can be produced.

The ATTORNEY-GENERAL: Here is the document admitted on the other side, and it contains, amongst other claims, this one which is struck out by the Attorney-General, and marked with his name. (To witness:) You opposed certain portions of their claim?

Witness: I did by means of my patent agent.

Mr. BOVILL: I object to that evidence.

Baron BRAMWELL: All I take down after the other objection is, "They handed in memorandum—Memorandum read."

Mr. BOVILL: They cannot swear to it. If this is offered as evidence in this case upon which the jury are to determine, it is very important that the person who was present when the Attorney-General did it should be present here.

Witness: The patent agent is here.

Baron BRAMWELL: All I can say in answer to Mr. Bovill's remarks is this, if he objects it is quite clear the document is not evidence.

The ATTORNEY-GENERAL: I only state it now, supposing Laming's evidence is set up, it will save time.

Mr. BOVILL: I shall object to it.

Baron BRAMWELL: Then do object.

The ATTORNEY-GENERAL: You had better read the document now, and then I will propose certain evidence upon it.

The ASSOCIATE read the consent of the parties to the admission of the copy deposit-paper as evidence in the cause without the production of the original.

The ATTORNEY-GENERAL: If my learned friend intimates that he is not going to set up Laming's case at all, or that if he does set it up he would prefer my answering it when the matter is before the court, instead of by anticipation, I will not press it.

Mr. BOVILL: I am not going to rely on Laming's case. I was not objecting to the paper generally, but to Mr. Hills' account of it.

The ASSOCIATE read the deposit-paper. The parts struck out were the following:—viz., those relating to the renovation of the purifying material,—also extracting sulphur and cyanogen compounds.

Examination resumed: It was upon my opposition that these passages were struck out. I gave instructions to oppose, and it was done.

By the ATTORNEY-GENERAL: I am not quite certain whether I attended at the Attorney-General's office. I am certain this passage was struck out.

Baron BRAMWELL: The effect of some unascertained cause.

By Mr. CHAMBERS: The specification was afterwards enrolled, and I found that the part struck out of the deposit-paper was in substance inserted in the specification.

The ATTORNEY-GENERAL read the passage referred to, as follows:—"Another part of our invention is the causing of impure coal gas to pass through dry-lime purifiers charged with a solid porous material, which we make by mixing, in about equivalent proportions, hydrated precipitated oxide of iron with carbonate of lime, magnesia, carbonate of magnesia, or magnesian limestone, in fine powder, or else burned and slaked, either by themselves, or rendered more pervious to the gas by sawdust or other suitable matter. A mixture of precipitated oxide of iron and zinc answers the purpose, and was claimed by one of us under a former patent." (Patent of 1847.)

Examination continued: When I discovered that that was in the specification, I conferred with my solicitor, and ultimately directed proceedings to be taken by *scire facias* to repeal the patent, which was done. I know as a fact, that an application was made to disclaim portions of their patent, and Mr. Murdock, my patent agent, was instructed to oppose the disclaimer. I had myself also been threatened with a *scire facias*, and I struck out my claim to mixtures of calcium, and all that I did not care particularly about.

The ATTORNEY-GENERAL handed in the judgment obtained by default in the proceedings against Evans and Laming, repealing their patent.

Baron BRAMWELL: Surely we need not have that solemnly read.

The ATTORNEY-GENERAL: No; it is only for the purpose of having it upon your lordship's notes.

Mr. BOVILL: If the grounds are stated, I should like to have them read.

Mr. CHAMBERS: I do not know what the grounds are; I only know that they had a patent, and that it was repealed.

Mr. HINDMARCH: The date of the judgment is April 27, 1852.

Baron BRAMWELL: It is quite clear that you, the defendants, have nothing to do with this. It is really matter of observation and contradiction when your witness, Laming, comes.

The ATTORNEY-GENERAL: I do not wish it to be read, but my friend does.

The ASSOCIATE read portions of the judgment showing the grounds for repealing the patent.

Mr. CHAMBERS (to witness): Did you find afterwards that they were working the patent?

Witness: They were trying to introduce hydrated oxide of iron under the colour of——

Mr. BOVILL objected.

Baron BRAMWELL: In consequence of learning that they were trying to introduce the hydrated oxide into use, did you take proceedings?

Witness: Yes, my lord; I commenced proceedings in *scire facias* against them.

Examination continued: These proceedings came to an end, and an agreement was entered into by deed on the 24th of July, 1852, between us. [The deed was produced and handed in.]

Mr. HINDMARCH stated the substance of it. It was made between Laming, Owen, Mertens, and plaintiff, and recited, first, the letters patent granted to Laming in 1847; and, secondly, the plaintiff's patent of 1849. The agreement was, that the record in the action of *scire facias* should be withdrawn, and that from the date of the deed Laming, Owen, and Mertens should have entire, full, and free licence and authority to use and practice the invention granted to Hills, so far as relates to the purification of gas, during the remainder of his patent; and certain specific gas-works in the metropolis were mentioned in the schedule as those in which Laming and Co. and Hills respectively might bring the process into operation.

Baron BRAMWELL: Were they at liberty to use this invention of hydrated oxide?

Mr. HINDMARCH: Yes, under Hills' licence, and on paying him a royalty, the amount of which was to be ascertained by arbitration.

Baron BRAMWELL: Then he has the privilege of using it for certain companies?

Mr. BOVILL: There are mutual permissions.

Mr. HINDMARCH: There is a precisely similar set of clauses on the other side, granting to Hills the right to use anhydrous oxides.

Mr. BOVILL: I cannot find any such words. That is your construction of the words, but I cannot find such words. The deed recites the patent to Laming, in 1847, and the patent to Hills. It also recites parts of the specifications, and gives permission to use the invention of Mr. Hills and the invention of Mr. Laming, but there are not those distinctions which my friend has pointed out.

Baron BRAMWELL: Each is at liberty to do it, and each has to pay a royalty to the other for the use of it?

Mr. BOVILL: Yes; the gas companies are to pay royalties, and, if they use one process, they are to pay to Hills; and, if the other, to Laming.

Baron BRAMWELL: The whole long and short of that is, that Mr. Hills acknowledges Laming's patent to be good, and Laming acknowledges Hills' to be good.

The ATTORNEY-GENERAL: I must, in vindication of Mr. Hindmarch, say that Mr. Bovill is in error if he supposes that anhydrous oxides are not mentioned in the deed. It states that—"The said F. C. Hills, &c., shall, from and after the date of these presents, have and enjoy full, free, and exclusive liberty, licence, and authority to use the two several patents and inventions so granted, &c., so far as the same relate to the purification of gas by anhydrous oxide of iron, during the remainder of the unexpired term, &c."

Mr. HINDMARCH: There is only this one clause beyond—"That, for all the purposes of this agreement, it shall be assumed that the said Messrs. Laming and Co. are entitled to anhydrous oxides, but not to any hydrated oxides; and it shall also be assumed as aforesaid that the said F. C. Hills is entitled to the use of hydrated oxides, but not of any anhydrous, &c."

Examination resumed: After that agreement was entered into, many gas companies used, and continue to use, my process, for which I was, and still am, paid royalties.

Baron BRAMWELL: Do any of them use the other process?

Witness: No; it will not purify gas at all.

By Mr. CHAMBERS: Mr. Laming is a manufacturing chemist, I believe. He has paid a great deal of attention to gas purification, and has taken out patents for it. Mr. Evans is the superintendent of the Chartered Gas Company's works at Westminster. In July, 1849, I asked for and obtained permission to try experiments at those works with reference to the purification of gas from ammonia. I was not then trying my experiments in reference to the purification from sulphuretted hydrogen. While I was making my experiments there, no communication was made to me by Evans or any other person with regard to any process which Laming was trying with oxide of iron. I am perfectly certain of that. I understood that Laming was there trying a process for taking out the ammonia by means of chloride of calcium. I did not see any process, and not a word was said to me about any process of purification by oxide of iron, nor did I know that any experiment of the sort was going on.

Baron BRAMWELL: Is the infringement admitted?

Mr. BOVILL: Yes. What I mean is, that the defendants have used hydrated oxide of iron and have revived it.

Mr. CHAMBERS: In the same way that we do it?

Mr. BOVILL: I do not say so.

Baron BRAMWELL: I should think that would do.

Mr. BOVILL: That the defendants have used hydrated oxide of iron for purifying gas, and have afterwards revived it by exposure to the air.

Baron BRAMWELL: For anything I know, there may be some marvellous way of using it which is no infringement. Do you admit that that has been done by you?

Mr. BOVILL: I do, but I do not wish it to be taken down in those terms; because a jury, if a counsel gets up and says the infringement is admitted, are apt——

Baron BRAMWELL: I should think you might trust the jury enough to say this—you have done that which you say you have a right to do, because the patent is not a good one, but which you would have no right to do if it were a good one. That will, I suppose, satisfy your nicety with the jury?

Mr. BOVILL: Yes.

Baron BRAMWELL: Then (between the jury and myself) I shall put down "Infringement admitted." But you are quite right to avoid an elastic word.

Mr. BOVILL: Quite so; and I explained it to show that I did not mean any qualification when I gave it to your lordship.

Cross-examination by Mr. BOVILL: I have taken out several patents for improvements in gas—four or five. I have not taken out eight or ten for gas. I have taken out altogether eight or more, but only once was required to lodge a deposit-paper. I was aware on each occasion that it was necessary to specify minutely what my invention was, so as to show clearly what I intended. In this particular case I was opposed, I am not sure who by; I think it was by Mr. Croll. I might have known at the time. I am almost certain it was Mr. Croll.

Mr. BOVILL: Am I to understand that you had never heard of the use of oxide of iron for purifying gas before 1848?

Witness: Hydrated oxide.

Mr. BOVILL: Had you known that oxides had been used before?

Witness: I knew there was a patent by Mr. Croll for using anhydrous oxides.

Mr. BOVILL: Point out a single passage in Croll's specification in which he says "anhydrous."

Witness: I can give you the effect.

Mr. BOVILL: I do not ask you that. Had you, before 1848, seen the specification of Mr. Croll's patent of 1840?

Witness: I had.

Mr. BOVILL: And you were aware that before 1840 oxides of iron—the general term, oxides of iron—had been said to possess the property of purifying gas?

Witness: I knew that oxides of iron had been said to do it, but I knew by the manner in which they were described that they would not.

Mr. BOVILL: Were you aware of Mr. Croll's having used oxides of iron?

Witness: No; I do not believe that he had ever used a particle.

Examination continued: I was also aware in 1848 of Mr. Laming's specification. I commenced experiments with oxide of iron at my works at Deptford in the autumn of 1848, at that time having seen both Croll's and Laming's specifications. I had no assistance in my experiments at that time. I think Mr. Dale was there occasionally all through 1848. I am able to affix the date of 1848 with certainty, because in that year the Deptford Gas Company erected dry-lime purifiers, and I know that it was in the year before that that I tried so many experiments. I discovered that the hydrated oxide would purify gas, and also the process of renovation—certainly as early as November in that year. I was not then aware that Mr. Laming had obtained a patent in France as well as in England. I did not hear of that until perhaps the middle of 1850. I was not aware until I made my experiments of the property of sulphuretted hydrogen to give off its sulphur by exposure to the air. I knew that pure sulphuret of iron would be converted into an oxide by exposure. I knew that it was so stated in books. I do not know that it is a fact which is well known. I may have stated it was on the last occasion. Mr. Dale saw these processes of purification by hydrated oxide and revivification by exposure to the air in the beginning of 1849, long before the patent was obtained. Mr. Barnard, the superintendent of the Deptford Gas-Works, also saw it. He was the person who allowed me to send in the material to those works, and he saw it as it went in and as it came back to me. He is here, and will tell you so. I did not inform him what the material was; certainly not. I suppose he would have a good idea of the matter. It is of such a character that I think persons at all acquainted with gas and chemistry would know what the material was. If they saw it change colour they would know. I did not explain to Mr. Dale what it was, but he saw it. The date of my last patent before 1849 was, I think, 1848, but I do not remember. It was in the early part of 1848. I am quite sure it was not in the latter part. The first time I practically applied this process on a large scale was not till 1851, though it was about November, 1848, that I was quite satisfied about it.

Mr. BOVILL: Was not your previous patent dated the 19th of October, 1848?

The ATTORNEY-GENERAL: It is an instrument in writing, and can be produced. The only patent I have heard of before 1849 was in 1846.

Witness: I think there was one in 1848.

By Mr. BOVILL: I was not trying experiments at the Chartered Gas Company at Westminster for so long as from July to October, 1849, but I can tell you the exact dates (referring to diary). We charged the gas company with seven days in July. I was only at the works twice during the period. I never had a man there—only myself and my brother. It was some time in July that the material was sent for the first experiment, and there was nothing done after the 1st of October. I believe I was not there in the months of September and October. The experiments were simply for the purpose of purifying the gas from ammonia by means of sawdust and water. I do not remember that I ever tried, or asked to try, any experiments there for taking away the sulphuret of hydrogen, and I did not know that at the time I was there Laming was making experiments for that purpose. I think I was informed that he was trying a mixture of chloride of calcium absorbed in sawdust for purifying gas from ammonia. I did not see the material taken out

of the purifier. [Model of Chartered works produced.] This model is not at all correct. That (pointing to one part) may represent the position of the scrubber where I was using the sawdust, but it is not in the same position with reference to the other parts of the works. I remember enough of the yard to know that this model is not at all correct.

Mr. Bovill: Did you never see any material thrown down at the time the work was going on?

Witness: What material?

Mr. Bovill: Did you see the material which came out of the purifier lying on any part of the works?

Witness: I might have seen lime. If you ask me whether I ever saw oxide of iron material, I say I did not.

Mr. Bovill: Did you see any material come out of the purifier?

Witness: I do not know what you mean. They were purifying with lime and chloride of calcium. I think I once saw some chloride of calcium, mixed with sawdust, lying by one of the large purifiers.

Mr. Bovill: Did you never see any of the material that came out of the purifiers where Laming's experiments were going on lying about?

Witness: I know now what you are referring to from what took place at the last trial. I never saw any.

Baron Bramwell: Saw what?

Witness: Never saw any material out of the experimental purifiers. I remember seeing some chloride of calcium and sawdust, because it had got so hard that they were picking it out with a pickaxe. That was a light grey colour. I did not see anything taken out of the purifiers and thrown down in a heap which had a black appearance, nor did I see another heap which had a red appearance. In 1849 I was making other experiments in reference to the purification of gas. I tried then, and am still trying, to prove the best methods of doing so.

Mr. Bovill: I see in your deposit-paper of 1849 you say your invention is for "compressing peat between inclined planes or rollers." When did you make your experiments to prove that that was valuable?

Witness: I was connected with the peat works then. I did not try it with machinery, but I thought it one of the best materials to make gas of. I did not try any experiments upon that peat, but I knew enough of the nature of the things to show that the process which I had described would be effectual.

Mr. Bovill: You felt justified, then, in putting, in "compressing peat between inclined planes or rollers, with absorbent substances interposed?"

Witness: There are many things which you can tell without experiments.

Mr. Bovill: Another part is, "For carbonizing coals in retorts or furnaces by passing atmospheric air through the fuel therein contained, and when sufficiently hot introducing the charge of coals to be carbonized, which coal should be previously heated, and then excluding the air; also, by passing highly heated gases through it in the retorts or furnaces." Be good enough to tell me when you arrived at the discovery of that process, or whether you made any experiments upon it, or whether it was only an idea?

Witness: I made a great many experiments previous to that time. I built one or two furnaces to try it.

Mr. Bovill: When did this idea of compressing peat between inclined planes or rollers occur to you?

Witness: I do not remember exactly—either 1848 or 1849.

Mr. Bovill: Your third claim is for obtaining alumina or alum from aluminous shale, for purifying gas or other purposes, by causing sulphuric acid to pass through it. When did you try that?

Witness: In July, 1849, and I found it did not do so well as I expected. It did purify gas, and it has been used commercially; but I never used it. The water plan is better.

Mr. Bovill: Your fourth is for the arrangement of pipes, &c., for distributing liquids in gas purifiers.

Witness: Those I have introduced to some extent in gas-works; they answered very well indeed.

Mr. Bovill: The next is, "For absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again by heat, &c., or taking off the atmospheric pressure." Is that how you describe the use of hydrated oxide of iron and the revivification of it?

Witness: I mean to say that it covers the use of oxide of iron very well.

Mr. Bovill: I ask you if that is what you mean? Is that your mode of expressing your great discovery of using hydrated oxide of iron and reviving it?

Witness: If you ask me whether I include oxide of iron, I say "yes." I was trying experiments at that time with other things, and I had to cover them with those terms. Nothing was intended to come under that description but the use of this invention of hydrated oxide of iron and the reviving of it; but I had other things upon which I was experimenting and in contemplation which I wished to cover.

Mr. Bovill: Is there a single other thing in your specification?

Witness: No. I wanted to cover the taking of sulphuretted hydrogen from gas, and I took that copy of the paper at the Attorney-General's after I had been in. The Attorney-General's clerk allowed me to go into his office and take a copy. This is the copy in my handwriting, with the Attorney-General's name at the back. I do not think I had more than five or ten minutes' time to write the deposit-paper in. I have no doubt that I had not a quarter of an hour. It was written not in the presence of the Attorney-General, but in one of his offices where the clerk sat, before I went in to him. I then went before the Attorney-General and presented the paper, of which this is a copy. That is, I believe, the only explanation I gave him. He might have asked me questions upon it, but I do not remember; I think it very likely. I think his clerk afterwards brought the paper out, and I took this copy. My sixth claim is for heating the coals, &c., to be carbonized before putting them into the retorts or furnaces. I cannot possibly remember when I made experiments upon that; I have a small gas-work on my works.

Mr. Bovill: At the time of that deed between you and Laming, did you arrange that you two were to agree so as to bring all the gas companies to take either one or other of your patents?

Witness: We could not agree to such a thing as that. We only agreed that it should apply to certain gas companies.

Mr. Bovill: Did you afterwards quarrel with Mr. Laming?

Witness: I quarrelled with him all along.

Baron Bramwell: A sort of chronic quarrel.

Mr. Bovill: You have had quarrels with gas companies?

Witness: Only on this question.

Mr. Bovill: Have you not moved for a new trial?

Witness: Several were begun.

Baron Bramwell: Were they tried?

The Attorney-General: No. My Lord Campbell, understanding that there had been a trial and a nonsuit, and a new trial obtained, would not go on with it.

Baron Bramwell: I must say that I think Guildhall is a much more convenient place to try a case of this kind than here.

Witness: It would have saved me a great deal of trouble and expense.

Mr. Bovill: The objection to trying it then was that, instead of going on with this case, the plaintiff brought a fresh action against some one else.

Cross-examination resumed: I have answered before that I never knew anything about the experiments going on by Laming, and did not trouble myself about them. I did not know that he was trying experiments with oxide of iron; I knew he was trying with chloride of calcium. Perhaps I might have made some inquiry, but I will not say one way or the other. I will not pledge my oath that I did not; I mean to say I do not recollect whether I inquired or not. I knew it was chloride of calcium and sawdust or lime, because I might have been told, and I saw the material. [Witness referred to model, and pointed out whereabouts the experiments took place.] I never heard Mr. Evans say that the stuff taken out of the purifiers turned red. He did not say a word about it. I never saw the purifiers as represented on this model. I made a disclaimer in 1853 of a good deal of my patent, retaining only all that I considered valuable. I did not disclaim everything except the hydrated oxide of iron and the reviving process. I believe there is the distributing of liquids over gas purifiers. I did not expand the six in the deposit-paper into nine claims in the specification; they may be divided into nine. I disclaimed all but three in 1853; those three were the hydrated oxide of iron, the reviving, and the distribution of liquids by means of supply-cisterns. I abstained from enrolling that disclaimer until 1856. I think the reason was, that a dispute took place with Owen and Laming, and we came to an agreement for them to take a licence for the hydrated oxide process. They were threatened with a *scire facias*, and there was no necessity to enrol the disclaimer until we began to quarrel again.

Mr. Bovill: Were you not aware that the Chartered Gas Company have continued from the experiments in 1849 to use hydrated oxide of iron.

Witness: They never used it before my patent. I believe from 1850 they have been using it, and they have been paying a royalty ever since. Up to last June I received the royalty from Owen and Laming, and they, as I understand, receive it from the Chartered Gas Company.

Mr. Bovill: Do you precipitate your hydrate of iron by means of gas liquor?

Witness: No; I have done it. That makes sulphuret of iron and carbonate of iron. Gas liquor is hydro-sulphuret of ammonia. Salt of iron put to it precipitates sulphuret of iron and carbonate of iron. If there were no salt put to it, I should have gas liquor still.

Mr. Bovill: Do you ever precipitate carbonic acid from the gas liquor before you use it?

Witness: I do not understand you.

Mr. Bovill: Is there carbonic acid in gas liquor?

Witness: Yes, there is. You do not precipitate carbonic acid alone, but carbonate of iron with it. It is a pure carbonate of iron.

Mr. Bovill: Is there any oxide of iron in it?

Witness: Carbonate of iron is a carbonated oxide of iron.

Mr. Bovill: Be good enough to tell me how you produce your hydrated oxide of iron with which you purify gas?

Witness: I obtain it already formed as a hydrated oxide. It is precipitated from certain waters in copper mines. I get it cheaper and better than making it, but I have made it frequently from sulphate of iron, which I have given the process of doing.

Mr. Bovill: Where do you get it from?

Witness: I do not think I ought to tell.

Mr. Bovill: You must.

Witness: From North Wales.

Mr. Bovill: What part?

Witness: From Anglesea—from Amlwch, from one of my brothers, who did reside there.

Mr. Bovill: From whom?

Witness: From Mr. Henry Hills, my brother. He has removed from there, but a gentleman is carrying on the business.

The Attorney-General: I think this is rather unfair.

Baron Bramwell: If the seller turns out to be the plaintiff's brother, I think there is not much fear of competition.

Cross-examination continued: We have made some at our works at Deptford, which has been used in various gas-works.

Mr. Bovill: Be good enough to explain how it is made?

Witness: Sulphate of iron is taken—common copperas—and hydrate of lime—*i.e.*, slacked lime—is added to it, and they are mixed up well together. That forms oxide by exposure to the air, and it becomes hydrated peroxide of iron.

Mr. Bovill: When did you last use gas liquor for the purpose?

Witness: I have only tried that by experiment, but it will not do. It is a very bad plan. I have thrown down hydrated oxide of iron mixed with sulphate of lime for the purpose of being used in gas-works to purify gas. I have never done that except with gas liquor. That is the carbonate of iron and the sulphate of iron, but that is not my process. If you have to precipitate it, I give a plan here—by mixing it with sawdust and exposing it to the air it oxidizes.

Baron Bramwell: I understand from what he says that you may make hydrated oxide of iron by using gas liquor to sulphate of iron, which throws down a carbonate of iron, and that turns into a hydrated oxide by exposure to the air.

Cross-examination continued: My patent was in 1849. I remember distinctly using gas liquor for the purpose of precipitating carbonate of iron and sulphuret of iron. You cannot precipitate hydrated oxide of iron from gas liquor; that is impossible. I do not think I used the gas liquor in 1850, except in experiments—for the purification of gas most distinctly not. I first got the oxide from Wales before 1848, but I am not quite sure when. I believe some of the iron-stones are hydrated, but I am not mineralogist enough to know, and I have not tried. There may be some of the iron ores in a state of hydrate. I have made hundreds of experiments, and I know that the anhydrous oxides will not purify. I do not know that there are certain hydrated oxides which will not purify, except some of the iron ores. I have not experimented upon the native hydrated or anhydrous oxides; but from my knowledge I should know that the latter would not purify, because I have experimented upon artificial oxides, which are obtained by heat. I certainly did not use the gas liquor in 1850 in gas-works; I might have tried it experimentally. [Paper handed to witness.] That is my handwriting.

Mr. Bovill: This is a letter dated the 23rd of April, 1850, addressed to Mr. Burls, of the Chartered Gas Company. It says: "I have also a plan to propose for purifying your gas without lime, and I should require the gas liquor to make the purifying materials." Now, I ask whether, in 1850, you were not using the gas liquor to make hydrated oxide of iron?

Witness: No, I was not. I have an immense quantity of gas liquor. This (pointing to specification) is a way in which it might be prepared. The plan referred to in that letter was my plan of hydrated oxide of iron, and I should have made it in that way, but I do not like it so well. If they had accepted my offer, I rather think I should have used all their gas liquor. Most likely at the time I wrote that I thought I should have done it in that

way. But I was not doing much at that time. I had tried it on a large scale, and found it took too long to precipitate. I think it was before I filed my specification that I went before the Attorney-General to oppose Laming's patent. I had then communicated to other persons that I claimed the hydrated oxide. I went round to try to get it introduced. I think the first companies I went to were the South Metropolitan and the City Companies. We were not before the Attorney-General together. I do not think any witnesses were examined; I believe not.

Baron BRAMWELL: Now, Mr. Bovill, you have thrashed out the last grain.

Mr. BOVILL: Would muriate of iron and lime produce oxide of iron?

Witness: That depends upon how it is done. There is a way in which it can be done. It all depends upon how I am told to do it.

Mr. BOVILL: Do you know how to make it?

Witness: There is a way to do it.

Mr. BOVILL: Do you know that way?

Witness: I do.

Mr. BOVILL: Do competent chemists know that way?

Witness: They do.

The ATTORNEY-GENERAL: What is that way?

Witness: Dissolving muriate of iron in water, and adding hydrate of lime to it, stirring it together. That will make protoxide of iron, not peroxide, like that used in combination with chloride of calcium.

The ATTORNEY-GENERAL: Is that the article for which you obtained your patent?

Witness: No; that is what I disclaim. It would make the hydrated protoxide of iron; but the chloride of calcium spoils its action. We produce them separately by our mode.

Re-examined by the ATTORNEY-GENERAL: Before I took out my patent I was well acquainted with the specifications of Croll and Laming's patents. There was nothing in either of those specifications from which I could derive the least information in making the article which I patented—there was nothing in them to suggest an idea. I had matured and completed the invention of the hydrated oxide of iron and sawdust and the process of renovation, as I have described it, before I wrote the deposit-paper in the Attorney-General's office. I meant to include hydrated oxide of iron in it. With respect to the renovation, I used the expression "or taking off the atmospheric pressure." If you take off the pressure, the air from beneath rushes through and completes the process. The model produced is so incorrect I should not have recognized it. There were none of the (arched) openings at the works in those positions. If I were standing at that scrubber, I could not see the back-yard. [Witness explained further discrepancies by the aid of a plan.] It was not till long after the date of my specification that I heard of any experiments, by Evans or any one else, to renovate the oxide of iron. Some of the gas companies continue to use my process to the present time, and others did so until this action and these disputes began. I ought to and have received considerable sums as royalties through Laming and Co., and the house which succeeded to them, but I have had a great deal of trouble to get them. The difference between hydrated oxide and ordinary oxide of iron is not palpable to the eye.

Dugald Campbell, Esq., examined by Mr. HINDMARCH.

I am analytical chemist at Brompton Hospital, and have had much experience in the investigation of the subjects relating to gas manufacture. I am well acquainted with the various processes ordinarily used in the manufacture and purification of gas. I have been so for many years, and have made experiments of those processes. I have considered the plaintiff's mode of purifying by means of hydrated oxide of iron, which is a peroxide of iron chemically combined with water. I have tried its effect upon coal gas for purifying it from sulphuretted hydrogen, and I find it does it quickly and effectually. I have also tried the renovation of the material, which is perfectly successful. I have experimented with anhydrous oxides, but they will not purify gas unless they are submitted to a high temperature. They would require to be heated before they would attack the sulphuretted hydrogen, and that practically could not be done in gas purification, because it would create a tendency to explode the gas and destroy the hydrocarbons, rendering it less luminous. Before the date of Mr. Hills' patent I was not at all aware of the use or application of hydrated oxide of iron for the purpose. I have read Croll's specification and examined it carefully. I do not find anything in it which indicates the use of hydrated peroxide of iron for the purification of gas, but the reverse. I should judge, in reading that specification, that he indicates the use of anhydrous oxides; for, if you turn to page 4, line 26, you will find that he says, "This material, after it has ceased to absorb the sulphuretted hydrogen, is to be removed from the purifying vessel and roasted in an oven to expel the sulphur which it then contains. After this material has become thoroughly red in the oven, I have found from two to three hours further time to be sufficient to accomplish this object, taking care that whilst it is being roasted it be well stirred about in the oven." As a chemist, I should say that if oxide of iron were to undergo that process, the result would be to produce an anhydrous oxide. I have read Laming's patent of 1847, and that part which describes the formation of chloride of calcium by decomposing muriate of iron by means of lime. If you put lime and muriate of iron together in a moist state, you would get a sort of slush, composed of chloride of calcium and protoxide of iron. Chloride of calcium is just one of those delequescent substances which is always in a moist state, and it is difficult to reduce it to a powder; and if it were then mixed with oxide of iron, and gas passed through it, or if it were exposed to the air, it would soon become delequescent again.

Mr. HINDMARCH: I see in the specification he says—"decomposing muriate of iron by means of chalk."

Witness: "Lime or chalk."

Baron BRAMWELL: What is the object of all this? Is it to show that these are not hydrated oxides of iron?

Mr. HINDMARCH: No, my lord; there is another part of the description—"by means of chalk," which cannot be done so as to produce a hydrated oxide.

Baron BRAMWELL: Then, in plain words, the mixture of chalk and muriate of iron would not produce oxide of iron?

Mr. HINDMARCH: Not if done in a moist state, and if done in furnaces there would necessarily be an anhydrous oxide produced.

Baron BRAMWELL: How can you produce this decomposition by means of chalk and muriate of iron?

Witness: It can only be done by employing a high temperature in a furnace.

Mr. HINDMARCH: And Mr. Laming in his patent says: "Chloride of calcium is both abundant and cheap, but under certain circumstances it may be desirable to make it, for the purposes of gas purification, by decomposing muriate of iron by means of lime, or of chalk when the latter will suffice. In such cases the oxide or carbonates which result are useful for the said purification and need not be removed. I do not claim either of these processes for making a mixture of chloride of calcium and a metallic oxide or carbonate, but I do claim the application of mixtures so made for the purification of coal gas;" but he says the chloride of calcium can only be made by means of chalk in a furnace.

Baron BRAMWELL: I will give it up. (After a pause his lordship said:) If you mix chalk and muriate of iron together to produce chloride of calcium, how must you proceed?—what takes place?

Witness: Nothing takes place, my lord, by mixing chalk and muriate of iron, nor will anything take place till you get a high temperature in a furnace, and then you have chloride of calcium and an anhydrous oxide of iron produced.

Baron BRAMWELL: We do not want to know what these things will make, but what they will not make. It is no use my putting down these chemical results if, after all, the witness is to say—they do not make oxide of iron.

Examination resumed: If you use lime instead of chalk it may be done in a moist state, and the result would be, an anhydrous peroxide; but if you use chalk, you must use heat.

By Baron BRAMWELL: The product would not be the same in both cases. In the moist way it is hydrated protoxide of iron, and in the dry way it is anhydrous peroxide.

By Mr. HINDMARCH: When the hydrated protoxide is got in this way it contains a mixture of chloride of calcium, and my experience indicates that it is not an efficient agent in the purification of gas. I have tried it repeatedly. I have read the next part of the specification, which relates to the use of carbonates. A carbonate and an hydrated oxide of iron are not the same things; they are perfectly different. A carbonate is a combination of oxide of iron and carbonic acid; it is a combination of an acid with a base, so as to bring it within the denomination of a salt. I have read the clauses in the specification as to precipitation by gas liquor. If you take gas liquor, and add it to a solution of muriate of iron, or manganese, or zinc—but say iron, you first reduce any protoxide in the solution into a peroxide.

By Baron BRAMWELL: In following this process you may get a carbonate of iron *per se*, or a carbonate and sulphuret of iron mixed together.

Mr. HINDMARCH: But he says here, "To obtain this carbonate in an economical manner, I throw down from ammoniacal or gas liquor obtained in making coal gas, and previously distilled or not, the sulphur which it contains; and, having drawn off the clear liquid, I next precipitate its carbonic acid, or instead of making two separate precipitates, I throw down a mixed sulphuret and carbonate of the precipitant." Now, supposing you had got rid of the sulphuret, and then applied the muriate of iron to the gas liquor, what would be the result?

Witness: Carbonate of the protoxide of iron; a white precipitate.

Mr. HINDMARCH: Is that the same as hydrated oxide or not?

Witness: It is not; and my experiments point out that it will not effect the purification of gas. I have tried it, and it does purify to a slight extent, but it would be valueless, comparatively speaking, in the purification of gas.

Mr. HINDMARCH: You were present at the last trial, and heard some of the evidence given. Since that trial have you yourself purchased from several chemists in various parts of the metropolis the article called carbonate of iron?

Witness: I have purchased what is called *ferri carb.*, which means the carbonate of iron of the *Pharmacopœia*. There is no other oxide sold in the chemists' shops. I have analyzed dozens of samples of *ferri carb.* It all depends upon the way in which they are manufactured whether they are hydrated or not. None of them were what is properly called hydrated oxide of iron. Some of them did not contain more than a slight trace of hydrated oxide—not more than 1½ per cent., and the largest of all contained 31 per cent., partly hydrated and partly carbonated. About 5 per cent. was carbonated and the other hydrated; the remainder, or about 70 per cent., was anhydrous peroxide of iron. I tried to purify gas with the most hydrated sample, both mixed with sawdust and without, and the experiment was a failure in every case. It might purify a very small quantity, but practically it was useless. If a person went to a chemist's shop and inquired for carbonate of iron, he would certainly not obtain what is properly called hydrated oxide of iron. This material, as I understand, is used as a medicine; and we made a calculation that, if purchased at a wholesale druggist's, it would cost about £60 per ton. There is nothing in either Croll's or Laming's specification which would lead me to adopt the process of renovation which I find in Mr. Hills'.

Cross-examined by Mr. BOVILL: In using the term oxide of iron, I should mean protoxides and peroxides; if I meant hydrated oxide I should say so. In my own book on chemistry, I fancy you will find the distinction drawn between the oxides. That book was published in 1851, and you can get it at Ballière's, in Regent Street. (A laugh.)

Baron BRAMWELL: But I suppose it is "sold by almost every bookseller?"

By Mr. BOVILL: Peroxides and protoxides may be either hydrated or anhydrous, but unless you stated which you required, chemists would not know which you meant.

Mr. BOVILL: Of course not, because it does include both.

Baron BRAMWELL: Is that so?

Witness: No, my lord; it *may* include them all.

Baron BRAMWELL: I think, Mr. Bovill, if you were to put your question—I was going to say, so that he could understand it, there would be no difficulty in answering it. Anhydrous is a negative expression: it means without water; hydrated, with water. Is one as much a normal condition of an oxide as another, or is the natufal condition of an oxide so understood to chemists that "hydrated" is a superadded quality which you say exists?

Witness: That is the case.

Mr. BOVILL: Well, he is brought round to my point again, and will be again.

Baron BRAMWELL: Don't make too sure of that. We all know your influence in Guildford.

Cross-examination resumed: Rust of iron is the common form of oxide of iron. I do not know that it is its commonest form. It depends upon how produced, whether it is hydrated or not. It is hydrated, precipitated in the way Mr. Hills describes. A person hearing the expression "oxide of iron" might understand rust as well as other things, but not of necessity. If you were to desire me to take an oxide, I should not know that I was to take rust, or I might not. Besides the oxide that is formed by the action of the atmosphere in the form of rust, there are oxides produced by other means.

Mr. BOVILL: And known as oxides of iron?

Witness: Known not as oxides, if you are talking of peroxides and protoxides. There are two oxides of iron only. The general term oxides of iron includes them both.

By Baron BRAMWELL: And of these peroxides and protoxides some are hydrated and some anhydrous; the term oxide including them all.

Mr. BOVILL: That is just what I was coming round to.

Baron BRAMWELL: But you have been a long time in doing it. Oxides of iron are twofold protoxides and peroxides, and the varieties of

both are of two kinds, hydrated and anhydrous, and each of them comes under the head of oxide of iron. I understand the difference between you and the witness is, that he says or suggests, or is made to say, that if he had to speak of oxide of iron, he would naturally use it without an epithet if anhydrous, and if hydrated, he would use that word with it. (To witness:) Supposing one of your children were to say, "What makes this rust upon the things here?" would you say that is hydrated oxide of iron, or merely oxide of iron?

Witness: I would say it is oxide of iron unless I knew that it was hydrated. There is nothing in the term "oxide of iron" to indicate which it is. It is a generic term. Both hydrated and anhydrous are found in a state of nature; they are also produced artificially. The artificial hydrates are produced by exposure of iron to the atmosphere; the anhydrous by the application of heat. It would not generally become anhydrous by mere exposure to the atmosphere; a little of it might. It is not necessary to employ a very high temperature to get rid of the carbonic acid; a moderate heat, not much above that required for boiling water, would do it, supposing it were continued for a long time.

Mr. BOVILL: Do me the favour to take in your hands Mr. Croll's specification. You will find there that he says, "The third part of my improvements in the manufacturing of coal gas consists in the application of the black oxide of manganese to remove or free coal gas of sulphuretted hydrogen, which is accomplished in the following manner:—After the gas has been freed from ammonia, as above described, it is then to be passed through a vessel similar to those now in use for the purification of coal gas by what is denominated dry lime, and charged in a similar manner with black oxide of manganese in powder, moistened with water to about the same consistency." But if you go down further you will find that he says, "The same effect may be produced by the application of the oxides of zinc and the oxides of iron, and treated precisely in the same way as above described." Having called your attention to that, I go back to where he says, "The third part of my invention, &c., consists in the application of the black oxide of manganese, &c." Now, substituting oxide of iron for the black oxide of manganese, which he says will produce the same effect, do you understand from that that it is an oxide of iron which will absorb sulphuretted hydrogen?

Witness: Yes; you have expressed it so.

Baron BRAMWELL: You have put a very difficult question to him, and in one sense a very captious one. That the inventor means that it should be such an oxide is evident, for he says it will do it. That he so meant it, therefore, is manifest; but I infer, from what Mr. Campbell has said, that he means an impossibility, because he goes on to speak of an anhydrous oxide which will not do it.

Mr. BOVILL: I am coming to that afterwards.

Baron BRAMWELL: But your question was open to so much doubt, that he must explain before he could give an answer.

Mr. BOVILL: I am coming to the next point, which is the renovation. He goes on to say, "This material, after it has ceased to absorb the sulphuretted hydrogen, is to be removed from the purifying vessel and roasted in an oven to expel the sulphur which it then contains. After this material has become thoroughly red in the oven, I have found from two to three hours' further time to be sufficient to accomplish this purpose, taking care that whilst it is being roasted it is well stirred about in the oven. After this operation is completed, the material is fit again to be employed, by being placed in the purifier, moistened with water, as in the first instance." Up to that point he had been describing an oxide of iron for the purpose of absorbing sulphuretted hydrogen, and then he describes the treatment to be adopted after it has been absorbed?

Witness: Yes.

Mr. BOVILL: Was it not perfectly well known to chemists that hydrated oxide of iron would absorb sulphuretted hydrogen?

Witness: It was known to chemists as an experiment in the laboratory. It was not a well-known fact. I do not know that I was aware of it until it was fairly pointed out in this invention of Mr. Hills. The fact of its not being applied is a proof that it was not well known.

Mr. BOVILL: I put it to you, in the presence of your brother chemists, whether in 1840 it was not known that hydrated oxide of iron would absorb sulphuretted hydrogen?

Witness: Upon my oath I think not. I never knew it until my attention was called to this patent.

Mr. BOVILL: Did you know, or was it known to chemists in 1840, that anhydrous oxides would also absorb sulphuretted hydrogen?

Witness: I suppose that would be about in the same state as the other. I am not aware that anhydrous oxides will absorb sulphuretted hydrogen now, unless heated to a high temperature. I have never been able to make it do so in my experiments. I do not know whether it was known to chemists in 1840 that it would not. I have no doubt that if you make it very hot it would do so.

Mr. BOVILL: The question I am asking you is—was it commonly known to chemists that, except under extraordinary circumstances, anhydrous oxides would not do it?

Witness: It will not absorb sulphuretted hydrogen from coal gas.

Mr. BOVILL: I am not asking you about coal gas, but about sulphuretted hydrogen.

Witness: It will decompose sulphuretted hydrogen.

Mr. BOVILL: Then are we to understand now that both hydrated oxide of iron and anhydrous oxide of iron will both absorb sulphuretted hydrogen?

Witness: Yes. They will not both absorb it from gas. It is only the hydrated that will do that. I have not known that as long as I have been acquainted with the profession. I first knew it three or four years ago. I have been in practice as a chemist fifteen years. I do not think it was known in 1840 which of the oxides would absorb sulphuretted hydrogen. I think the subject has been developed by Hills' patent.

Mr. BOVILL: Not at all by Mr. Croll's, which says that it may be purified by oxides of iron?

Witness: It never was known as far back as 1840 that hydrated oxide of iron would purify gas.

Mr. BOVILL: How can you undertake to say that Mr. Croll did not know it?

Baron BRAMWELL: I call that a little hard upon the man. You ask the question so that he shall answer it in a certain way, and then complain because he does so.

Cross-examination resumed: Mr. Croll speaks of the material, after having absorbed the sulphuretted hydrogen, being removed from the purifying vessel and roasted in an oven to expel the sulphur. Sulphur would not be expelled at a temperature considerably below a red heat; I have made experiments to ascertain that, upon a large scale. If heated to a red heat, the sulphur would ignite if the vessel was not closed. After being roasted in an oven not at a red heat, the material on being exposed to the atmosphere would become of a red colour. During the process it would not be red, but it would remain of a black colour till exposed to the air. Even if it were an open oven and you were to blow air over it, it would not become red. If you were to carry on the process for a long time the sulphur might ignite, but I have seen it carried on for twelve hours with stirring; and on looking at the stuff in the oven it was quite black, although the temperature was that of a low red heat. At a lower temperature it would still remain black until exposed to the air.

Mr. BOVILL: Is it because you find here that it is to be kept in the oven till it is thoroughly red, that you infer it is anhydrous?

Witness: That is one reason; it is to "become thoroughly red," and he says, "I have found from two to three hours' further time to be sufficient to accomplish this object, taking care that whilst it is being roasted it be well stirred about in the oven." I infer from that, that an anhydrous substance is wanted, because that temperature will drive off all the water. Another part from which I infer that it is, is that in which he refers to the use of the black oxide of manganese. I pledge my reputation that black oxide of manganese, as it is understood, is anhydrous. It is found in a natural state, but very rarely hydrated—about as often as iron is. I was first consulted about this matter two or three years ago. I did not receive a retainer.

Baron BRAMWELL: That is not such a bad thing to receive, Mr. Bovill.

Mr. BOVILL: When did you first read Mr. Croll's specification? Was it just before the last trial—I mean the one before Lord Campbell?

Baron BRAMWELL: That was no trial—I wish it had been.

Cross-examination resumed: I stated on the trial, in 1856, that I read these patents for the purpose of the trial, and also made the experiments with the same object. There was no one present on behalf of the companies when I made those experiments. I made them in various places; in my own laboratory, at King's College Hospital, and at Deptford at Mr. Hills' works. I should not suppose that Mr. Croll means that the black oxide of manganese was to be made red-hot at the commencement of the process. I do not know that it does absorb sulphuretted hydrogen from coal gas to any extent; it does do it slightly. I have tried it in my own laboratory with gas from my own gas-pipe, into which I injected sulphuretted hydrogen. That is not the way in which I have made all my experiments. The first I made was with gas from the Deptford Gas-Works. The gas at Mr. Hills' premises was from the hydraulic main before being purified, and supplied from a pipe laid on for the purpose. If you want to decompose muriate of iron with lime, you may do it in a wet or dry state; but with chalk it can only be done in the dry way. The protoxide of iron by exposure to the air becomes a hydrated peroxide. I have seen the *London Pharmacopœia*. I know it was referred to on the last occasion, but I have not taken the trouble to look at it since. That which is commonly known amongst chemists as carbonate of iron, and described in the *Pharmacopœia* as such, is not in fact hydrated oxide of iron. I believe it is not in the *Pharmacopœia* now. I am not aware that from time to time it has been called by different names. I am not aware that it has ever been called carbonate of iron, or sub-carbonate of iron. Hydrated sesqui-oxide of iron is the proper name for it. I do not believe there is such a name in the *Pharmacopœia*; as such, is not in fact hydrated oxide of iron. I believe it is not in the *Pharmacopœia* now. I am not aware that from time to time it has been called by different names. I am not aware that it has ever been called carbonate of iron, or sub-carbonate of iron. Hydrated sesqui-oxide of iron is the proper name for it. I do not believe there is such a name in the *Pharmacopœia;* it is too scientific for them. *Ferri carb.* is not in it now, and has not been, in my memory. The *Pharmacopœia* is the authority from which all physicians make up their prescriptions, but there are many expressions used there that chemists do not know anything about. There is a substance called *ferri carb.*, and in some shops you may get it. I sent to Apothecaries' Hall to get some, and they told me they had no such preparation. I know the mode of preparing it according to the *Pharmacopœia*. [Copy handed to witness.]

Mr. BOVILL: That is the *Pharmacopœia* of 1851, but it also gives the different names from 1741. I just ask you whether the preparation there described does not give hydrated oxide of iron?

Witness: The description I read in the *Pharmacopœia*, as far as my recollection serves, would, if properly carried out, produce some hydrated oxide of iron. You would get a mixture of anhydrous and hydrated oxide, and, if not carefully carried out, you would get, perhaps, no hydrated. What I call strict carbonate of iron does become hydrated peroxide by simple exposure to the air. *Ferri carb.* is a well-known term among manufacturing chemists, meaning what it is. Carrying out that experiment as carefully as could be done by a scientific chemist, you could not practically get hydrated oxide of iron. If you took carbonate of iron and mixed it with sawdust in the open air, it would become hydrated oxide of iron in the course of time; but I have seen some that has been so mixed for three or four weeks (not more than a few bushels, which is a small quantity for purifying), and put in a dry place where there was an access of air, and yet at the end of that time I found plenty of carbonate of iron in it. The greater part had not become hydrated, but was undecomposed carbonate of iron. The quantity of oxide in the carbonate all depends upon how it is prepared.

Mr. BOVILL hauded to witness the *Pharmacopœia* of 1809, and was proceeding to examine him thereon as to whether the mode of preparing the *ferri carb.* there spoken of would not produce a hydrated oxide of iron.

The ATTORNEY-GENERAL objected. He said: We have had notice, unhappily, of a great number of scientific works, or extracts from them, which it is intended to urge against us, but this is not one of them, and I do not see how it can be evidence.

Baron BRAMWELL: As far as I can understand, the object is not to show that this invention was known before, but merely in order to ascertain the meaning of a word.

Mr. BOVILL: That is all, my lord.

Baron BRAMWELL: I confess, I think it is open to objection on a different score.

The ATTORNEY-GENERAL: It is open to half-a-dozen objections.

Baron BRAMWELL: Just let me see whether I apprehend rightly. You are endeavouring to make out that the authors of that book describe hydrated oxide of iron, and call it carbonate of iron. Suppose they do, what then?

Mr. BOVILL: The *London Pharmacopœia* is the book from which all physicians wrote prescriptions. The thing was known there, and we are dealing with a thing supposed to be known. Mr. Laming is a medical man, and he used it. This gentleman (Mr. Campbell) undertakes to say that carbonate of iron is one thing, and my question is, whether the process described here for making it does not produce hydrated oxide of iron?

Baron BRAMWELL: What you mean to say is, that Mr. Laming made the same mistake as the people in the *Pharmacopœia*, and that when he said carbonate of iron he meant hydrated oxide of iron.

Mr. BOVILL: Not that; he made the mistake as well as they, but, as the Attorney-General says, unguardedly said so.

Cross-examination resumed: I find that the description here given would produce a mixture of hydrated oxide of iron and carbonate, principally carbonate. I am presuming that these things are done on a large scale for manufacturing purposes, and not in a few grain experiments. You cannot precipitate hydrated oxide of iron by gas liquor. It depends upon the fact whether there is any ammonia in it, whether you can do it after you have precipitated with carbonic acid. Gas liquor consists of two things, hydrosulphuret of ammonia and sulphate of ammonia. I do not know that Mr.

Hills has used hydro-sulphuret of ammonia in his patent, but it is not a correct term.

Baron BRAMWELL: I am told upon good authority that in the new nomenclature of chemists, they call it sulphuret of ammonium instead of hydro-sulphuret of ammonia.

Mr. BOVILL: Just as they call carbonate of iron sesqui-oxide of iron.

Re-examined by the ATTORNEY-GENERAL: My experiments prove that the carbonate of iron purchased at the shops would not serve to purify gas according to the process shown here. I took the most hydrated specimens which I could find, and operated upon the gas with them mixed with sawdust and *per se*, and found they were almost valueless. If it could be so applied it could not be renovated after the first process had been gone through. What hydrate there was in it would be revived, but no effect would be produced on the other part, which does not purify, and therefore cannot be revived. The carbonate described by Laming, and which he says could be economically prepared by throwing down from ammoniacal or gas liquor the sulphur which it contains, and, having drawn off the clear liquid, precipitating the carbonic acid, is as distinct a thing as possible to hydrated oxide. The terms carbonate and precipitate and carbonic acid are absolutely inconsistent with the substance, being a hydrated oxide, which has no carbonic acid in it at all.

By Baron BRAMWELL: That which is precipitated by Mr. Laming is the carbonate of protoxide of iron. When he says it is thrown down or precipitated, he puts a solution of sulphate or muriate of iron into the ammoniacal liquor, and that precipitates the iron oxide of the salt so thrown in.

By the ATTORNEY-GENERAL: This (exhibiting a bottle) contains a carbonate of iron precipitated from gas liquor, and it is as distinct from oxide of iron as lead or tin. I have said the term oxides of iron may mean either hydrated or anhydrous—it may include them both. The expression in Croll's patent, "The same effect may be produced by the application of the oxide of zinc and the oxides of iron, &c.," would not indicate to me that a hydrated oxide was to be used; there is nothing throughout that patent that would indicate it.

Baron BRAMWELL: But is there negatively anything to indicate that it is not to be used?

Witness: Well, reading the whole thing, I look upon it as an anhydrous oxide.

By the ATTORNEY-GENERAL: After being roasted in an oven, as there described, whatever oxide was employed it would become an anhydrous peroxide of iron; so that if any one reading this patent had, in the first instance, used hydrated oxide, and gone through the process of effecting a single purification, he could not have done it again. I have made every experiment pointed out in Laming's and Croll's specification and have not been able to succeed in purifying gas. There is no difficulty in doing it by Mr. Hills'; it is a very beautiful experiment of science.

By Baron BRAMWELL: If hydrated oxide of iron were used in the way described in Croll's patent for absorbing sulphuretted hydrogen, the proper course to proceed to get rid of the sulphur would be to take it out of the purifier and lay it out exposed to the air. That is a good process; the roasting in an oven is a bad one. If a man did not know anything about the reviving process, the first suggestion which occurred to him for getting rid of the sulphur might be to roast it in an oven. Any amount of heat which would be sufficient to burn off the sulphur would be sufficient to convert the material into an anhydrous oxide. The expression "thoroughly red in the oven" must mean a red heat; because it is a curious fact that both oxides, if they are red before they are put in, are made black while roasting. I should read that expression as a red heat.

Baron BRAMWELL: I do not think that is right, because the expression is "thoroughly red."

By Mr. BOVILL: I did not see the carbonate in this bottle made; but I have tested it, and know that it is carbonate of iron.

Dr. *Edward Frankland*, examined by the ATTORNEY-GENERAL.

I am a professor of chemistry at St. Bartholomew's, and have had considerable experience in chemistry, especially in reference to the manufacture and purification of gas, during the last ten or twelve years. I am acquainted with the patent process of Mr. Hills, which I think is so described in his specification that any intelligent workman could carry it out. As far as my knowledge and experience goes that process was entirely new at the date of the patent. I never knew that hydrated oxide of iron, either combined with sawdust or used separately, was previously employed for such a purpose and in such a form. I believe the process of renovation was also quite new. I think it is calculated to attain the desired end, and is an undoubted improvement in the manufacture of gas. I have read Croll's specification, and I entirely agree with Mr. Campbell that the oxide intended to be used by him must be anhydrous from the process here described. There is nothing in the paragraph indicated that could possibly be interpreted to mean a hydrated oxide.

Baron BRAMWELL: Would it be inconsistent with its use?

Witness: The hydrated oxide, if roasted, would infallibly be converted into an anhydrous; so that if hydrated in the first instance, it would be no longer so.

By the ATTORNEY-GENERAL: Referring to Laming's specification, when he says "the oxides or carbonates which result are useful for the said purification," I should say it would certainly be the carbonate of iron that would be obtained by the process, after distilling off the sulphur as mentioned. He would never get hydrated oxide, which has no carbonic acid in it. I know the substance called *ferri carb.*; it is not the same substance as hydrated oxide of iron. If you employed a sufficient quantity, you might purify gas with it, because there is a small quantity of hydrated oxide of iron in it; but you would have to use an immense quantity, and therefore it would be quite inapplicable in practice. As far as I recollect his evidence, I agree with Mr. Campbell as to the effect of this specification.

Cross-examined by Mr. BOVILL: If you went to get *ferri carb.*, you would get a dry red powder. I think a considerable portion of it would not be hydrated oxide, but if kept a sufficient length of time, under ordinary circumstances it would become so, as it would slowly give off its carbonic acid and absorb oxygen. I have not made any very accurate experiments with it. You cannot get pure carbonate; this is prepared in a different way. There are two or three processes mentioned in the *Pharmacopœia* for preparing *ferri carb.* There is the red oxide of the Edinburgh College, in which there would not be a trace of carbonic acid, but which is an anhydrous oxide. There is also the one generally used, which is prepared by adding a solution of alkali to one of green sulphate of iron. If that could really be done, you would get a pure carbonate of iron.

Baron BRAMWELL: But the process is so difficult that it eventuates in an oxide.

By Mr. BOVILL: You would thus form a mixture of the carbonate of iron with a small quantity of hydrated oxide. If you tried it at an extremely high temperature, you would obtain a hydrated oxide. There are both native and artificial oxides. The native do not purify gas, because they are generally in a peculiar molecular condition, that they are not readily acted upon; the artificial hydrates do. I have been in the profession about twelve years. I have been aware for a long time that anhydrous oxides would not absorb sulphuretted hydrogen from coal gas. I cannot say that it has been a matter commonly known; it might have been rather a matter of opinion than knowledge. If told to try oxides of iron to purify gas, I dare say I should have tried them all, the cheapest and most easily obtained first; and if I entertained a strong opinion that the anhydrous would not succeed, I should have tried the hydrated. I am not aware that there are some anhydrous oxides that will purify. I have heard of patents being taken out for it, but I understood that they had not succeeded. A great heat would render an oxide anhydrous. I have tried experiments according to Croll and Laming's specifications. I have also precipitated a quantity of salt of iron with gas liquor, by which I obtained a mixture of the carbonate of the protoxide of iron and sulphuret of iron. This mixture was then calcined in a furnace. I allude to this experiment, because the mixture was in exactly the same condition in which you get it for the purification of gas. I mixed it with sawdust, and tried its effect upon impure gas, but it did not purify any appreciable quantity; from which I should conclude that the sulphuret obtained from the hydrated oxide would also not purify if treated in the way described by Croll, because the heat is so great that the sulphuret, on being roasted, is converted into an anhydrous oxide. A red heat, visible in the day-time, will take place at about 1000° Fahr.; in the dark at as low as 700°. If hydrated oxide of iron which had imbibed sulphuretted hydrogen from gas were subjected to a heat in a close vessel of less than one half of that, the sulphur would not be driven off. In an open vessel it would depend upon whether you passed a current of air through it. The sulphur would not distil off except at a temperature of 700°. In an open oven, with a current of air, it would do so at something lower—perhaps between 600° and 700°—and without the oxide coming to a full red heat. If it did, the sulphur would get into a state of combustion and explode, supposing a current of air were passing through it at the time.

Dr. *Alfred Swaine Taylor*, examined by the ATTORNEY-GENERAL.

I am a professor of chemistry at Guy's Hospital, and have been acquainted with the subject for many years. I have considered the patent and specification of Mr. Hills both as to the purifying of gas by hydrated oxide of iron and the renovation of the material so employed, and to the best of my judgment, knowledge, and experience, it was entirely new at the date of the patent. I have read Mr. Croll's specification of 1840, and have repeated his experiments; likewise those of Mr. Laming's. Neither of those specifications indicate to me an article of the nature of hydrated oxide of iron or any means whatever of resorting to the process described by Mr. Hills, either with reference to purification or renovation. Taking Mr. Campbell's and Dr. Frankland's evidence generally, I agree with them.

Baron BRAMWELL: Is this the paper which you gave to me, containing all the names which *ferri carb.* has gone by since 1709?

Witness: It is.

The ATTORNEY-GENERAL: Is the *ferri carb.* sold in the shops the same as that indicated by Mr. Hills in his specification?

Witness: It is not.

Cross-examined by Mr. BOVILL: I was the principal witness on the last trial. I was called in first as an arbitrator for Mr. Hills. I have been in the profession since 1831. As far back as 1840 it was known by me, and by chemists of ability and experience, that hydrated oxide of iron would absorb sulphuretted hydrogen. I believe it was also known that anhydrous oxides would not do so, except under certain circumstances, and with the application of heat. The native hydrated oxides will not purify readily. They do better than the anhydrous oxides, but they cannot be practically used. There are several native hydrated oxides, and several artificial ones. I stated on the last occasion that hydrated oxide of iron was formerly called carbonate of iron, or sub-carbonate of iron, and was used in medicine. It was so called, but the term is not proper as put in their case. What is really sold in the shops is only partially hydrated. I wish so far to correct what I said upon the former occasion, that what is generally sold in the shops is not hydrated.

Mr. BOVILL: Did you not say, "I know that there is a carbonate of iron, so called, but it is a misnomer; there is not a carbonate, it is a peroxide of iron?"

Witness: There is no carbonate of the peroxide I said, or, at least, that is what I intended to say.

Cross-examination continued: It would require a red heat from 900° to 1000° to remove the water from the oxide of iron and convert it into an anhydrous oxide. I have seen gas liquor used, and have used it myself. I have produced hydrated oxide of iron by making it in a particular way when I sedulously sought to produce it, but the addition of gas liquor to sulphate of iron produces sulphuret of iron and carbonate of the protoxide of iron. It was known before 1840 that hydrated oxide of iron absorbing sulphuretted hydrogen could be restored by exposure to the air. Some sulphur would be deposited with it.

Baron BRAMWELL: You say it was known that hydrated oxide of iron would absorb sulphuretted hydrogen, and known, also, that it would give it off again. Let me ask you, then, what is the novelty in the plaintiff's invention?

Witness: It is this, my lord. With regard to the scientific fact, it was stated that in forming sulphuret of iron the sulphuretted hydrogen could be absorbed by oxide of iron, and on being exposed to the air, unless rapidly done in a close place, it would pass into a hydrated oxide. But its application to the manufacture of gas was not in the least known. This, as an application in chemistry, is mentioned by Berzelius; and he states it is necessary to dry it in a close place, or it will very soon pass into its original state. But although he gives an account of the purification of gas, he does not say anything about this being used for the purpose. He mentions the use of lime, and that was used chiefly for the purification of gas. As a scientific fact this was known, but its application to gas was not known.

By Mr. BOVILL: It was well known and stated in chemical works that sulphuret of iron would give off its sulphur. The effect would be increased by a rapid current of air. I think I first became aware of Croll and Laming's patents shortly before the trial which took place before the Chief Baron two or three years ago. Gas liquor contains a considerable portion of hydro-sulphuret of ammonia. If used in connexion with muriate of iron, it would not throw down a hydro-protoxide of iron, but a sulphuret of iron, which would become hydrated oxide by exposure, but not perfectly so; it is only on the outside where the change would take place. That is the only portion that would become converted.

By the JURY: Previously to 1840 the oxide of iron was known for making sulphuret of iron and no other purpose.

By Mr. BOVILL: For a long time hydrated oxide was the name used in chemistry, but it is now called sesqui-oxide. The same thing was termed before "carbonate."

Mr. BOVILL: The question was put to you on the last occasion, "Was

not the sesqui-oxide formerly called carbonate of iron?" and your answer was that it was.

Baron BRAMWELL: Was there such a thing as carbonate of iron known in 1836—such a thing in nature, or could it be made—a real carbonate of iron?

Witness: Yes; a carbonate of the protoxide.

Baron BRAMWELL: What do you call it now?

Witness: That is still called carbonate of iron. There is no difference in that, but it is not the medicinal preparation which you get at the shops. It has been known ever since the salts of iron have been known, but they have amended their ways now and call it sesqui-oxide. That carbonate (pointing to a bottle) is not the same as sold in the shops.

By Mr. BOVILL: Whether it is hydrated or not depends upon the way in which it is prepared. I have never found hydrated oxide of iron in the shops.

Some conversation took place in reference to the evidence given on the last occasion, in the course of which—

Baron BRAMWELL said: Do not let us get into the same difficulty again—Hydrated oxide was formerly called carbonate of iron in the *Pharmacopœia?*

Witness: Yes, in medical prescriptions.

Baron BRAMWELL: If I understand, what you mean is this—in reality and in true scientific nomenclature there was a thing called and known as carbonate of iron, and there is so still. There was also, and there is so still, a thing called or known as peroxide, which was either hydrated or anhydrous, and which is now called sesqui-oxide. But formerly chemists and druggists, physicians and others, who were not scientific chemists, called the preparation sold in the chemists' shops, and which might have more or less of hydrated oxide of iron in it, but never was pure hydrated oxide of iron—they called that carbonate of iron, and called it so wrongly?

Witness: Quite so.

By Mr. BOVILL: Having been so called in pharmacopœias, it found its way, as I stated on the last occasion, into some encyclopedias and dictionaries. It was in the text-books before. There is no other carbonate sold in the druggists' shops; but I cannot answer that there is no other article sold under that name. Unless kept from the air, it very rapidly becomes hydrated oxide. I have kept it corked up under water seven or eight weeks.

By the ATTORNEY-GENERAL: The article sold as carbonate of iron in the druggists' shops twenty-two years ago was the precipitate of iron, which by washing had lost its carbonate and become hydrated oxide. They did not heat it then to the same degree as they do now. When carbonate of iron is mentioned in Laming's specification, there is nothing to indicate that he means oxide of iron. Until the date of Hills' patent I never heard of, nor is it mentioned in any scientific work, that hydrated oxide of iron, charged with sulphur in the process of purifying gas, would be renovated by exposure to the atmosphere, nor as applied to the manufacture of gas. As an instance of that, I have referred to Berzelius himself. When the gas passes through the hydrated oxide of iron with sawdust, there is a great deal of impure thick gaseous matter, which is left in it, as well as the sulphuretted hydrogen, which it absorbs; it would, therefore, require experiments to be made in the actual purification of gas before the fact could be ascertained, notwithstanding the propositions of science that the exposure to the air would remove the sulphuretted hydrogen. What Berzelius refers to is merely a compound of iron, but the product of gas-works is a very complex material, which might quite alter the position. The result of such experiments is very correctly described in Mr. Hills' specification, so that any one can follow it very clearly. [Witness referred to the passage in Berzelius.] As an abstract scientific proposition, I should not know that the effect of exposing the hydrated oxide of iron to the atmosphere would be to deprive it of its sulphur, and enable it to go through the whole process again. Experiments would be necessary for the purpose, because, *à priori*, a chemist might suppose that a portion of the sulphur would remain to arrest that chemical action. Looking at it with regard to the manufacture of gas, there is a quantity of sulphur separated, and that might form over the particles of oxide of iron, and prevent the use of it for another process. It might also be that the temperature would be raised very high, and sulphuret of iron be formed, and thus damage the result; so that it is a pure matter of experiment.

WEDNESDAY, AUG. 11.

Professor *W. H. Miller*, examined by the ATTORNEY-GENERAL.

I am a professor of Chemistry at King's College, and my attention has been called to the manufacture of gas in connexion with the science of chemistry during the last twenty years. I am acquainted with Mr. Hills' patent of 1849. Until the publication of that patent I am not aware that hydrated oxide of iron was ever applied to or suggested for the purification of gas. Before that time lime was chiefly used. When hydrated oxide of iron mixed with sawdust is employed for taking away the sulphuretted hydrogen, the operation is this: the oxygen of the oxide of iron combines with the hydrogen, the iron takes up the sulphur, and that converts what was a gas into water and a solid body. No doubt it was well known before that oxygen would unite with hydrogen and form water, and that iron would unite with sulphur and form sulphuret of iron; but the compound operation in the way I have described, as applied to the purification of coal gas, was never known before. A scientific chemist would anticipate that possibly sulphuretted hydrogen might be absorbed, but he could not possibly tell that it would answer as a manufacturing operation *à priori*. The use of the oxide of iron could only answer commercially if it could be repeatedly used for this purpose. The absorption of the sulphuretted hydrogen would be valueless, comparatively, in the process of purification of gas, and it could not be publicly known till experiments were tried that the same material could be used over and over again in the way Mr. Hills describes it in his specification. When the material is removed from the purifier after the sulphuretted hydrogen is absorbed, it consists of hydrated sulphuret of iron mixed with sawdust. There are also some cyanogen and tarry matters, and sometimes a small quantity of ammonia present. When exposed to the air a renovation of the oxide of iron takes place. The act of renovation is an act of oxidization; that is, it is a combination of the oxygen of the air with the iron of the sulphuret of iron, which sets free the sulphur, and the oxide of iron entering into combination with the water which was before combined with the sulphuret of iron. It was a hydrated sulphuret before, but by renovation it becomes a hydrated peroxide of iron. We must describe the processes which thus take place successively, but they are effected simultaneously. It is simply a displacement of the sulphur by the oxygen of the air. It is a process which takes time when there is a large mass to be oxidized. It was well known beforehand that the oxygen of the atmosphere would unite with the iron, and that water would unite with the oxide; but until the process of renovation was pointed out by this patent, no one could have anticipated that the renovation of such material as is taken away after the purification of gas in large masses would be effectual. It was entirely a question of experiment whether, on a manufacturing scale, it could be done. The presence of the tarry matter exercises a very peculiar effect upon the process of oxidization, and it could not have been known, except as the result of experiment, that the presence of the cyanogen or this tarry matter would not altogether prevent oxidization.

Baron BRAMWELL: It might not be inconvenient to put this question here: From what cause is it, that after some twenty renovations or more, the material is no longer good for the purpose?

Witness: The pores get mechanically choked up, and the proportion of sulphur becomes three or four times as great as that of the oxide of iron with which we began. The sulphur is not separated from the mass in any way, but goes on accumulating.

Baron BRAMWELL: So that it becomes what may be called diluted with it?

Witness: Yes; and more than that, it mechanically obstructs the course of oxidization.

By the ATTORNEY-GENERAL: In 1848 there was nothing, I believe, in the then state of the science of chemistry which would enable the most accomplished and sagacious chemist to determine without experiments that this process would be practically applicable to the purpose. I have seen Croll's patent. There is nothing in the paragraph beginning—"the same effect may be produced by the application of the oxide of zinc and the oxides of iron," &c., to point out whether the oxides there mentioned should be hydrated oxides. Indeed, I should gather the contrary, because he speaks of heating it to a red heat; and, therefore, as a practical scientific man, if I had to attempt to bring this process into operation, I should take an anhydrous oxide. If I had taken a hydrated oxide in the first instance, when I had gone through the operation there described the bulk of the material would have become anhydrous; so that by Croll's patent you could not purify gas by hydrated oxide of iron and then go on with repeated renovations.

By Baron BRAMWELL: In other words, the operation there described would be impossible with a hydrated oxide of iron.

By the ATTORNEY-GENERAL: I read that paragraph as a direction to use the black oxide of manganese, but iron is permissive.

Baron BRAMWELL: That is very important, because it may have been a mere random hit on the part of Mr. Croll. I should like to ask this witness whether he knows what black oxide of manganese will do?

Witness: I know it will not purify gas effectually: it will to a certain extent. I should be sorry to take a licence for such a process. Black oxide of manganese is met with in the hydrated as well as anhydrous form; the hydrated would be much better than the anhydrous for this purpose. It is a much more dense and compact substance than the oxide of iron; and, though it certainly would arrest a portion of the sulphuretted hydrogen, it could not be practically useful, and the roasting would make it anhydrous. The oxide of iron is freer in its combination, and it blackens immediately that the absorption of sulphuretted hydrogen begins; but the oxide of manganese scarcely changes. Perfectly pure anhydrous oxide of manganese is not so common as hydrated. Probably a man speaking of the black oxide might mean the hydrated, but perhaps not. I do not know anything about it. The black oxide is not sold. The anhydrous would fetch more money in the market, because it contains more oxide than the other, and it is for that that it is chiefly valuable. Possibly, if Mr. Croll knew, he might have had the hydrated black oxide in his mind when he made his specification, and he might have known of the substance as a matter of fact. The term, "a roasting heat," is a very indefinite expression; it is generally a dull red heat. I should doubt whether there could be a heat sufficient to expel the sulphur, and yet not take away the hydrate from the oxide. If air were present during the process of roasting, the sulphur would burn; if not, it would distil off, but it would require a high temperature for distillation—700° or 800°. Sulphur takes fire at about 500°, and that would be a low red heat, which without great care would be sufficient to unhydrate the oxide.

By the ATTORNEY-GENERAL: You can get any heat you choose in an oven—a full red, a dull red, or a black heat. The expression here used refers to the black oxide of manganese, and it is ambiguous. I do not know whether it means roasting till it becomes red-hot, or till the oxide becomes of a red colour. I should think it must mean red-hot.

Mr. BOVILL submitted that that was rather a question for his lordship to determine.

The ATTORNEY-GENERAL said it was always a most difficult question what was for the judge and what for the witness to determine; but if in the construction of a passage like this they were not to have the aid of a scientific witness, there was certainly a great defect in the law.

Baron BRAMWELL: In point of strictness, I take it that you could not put that question, but you might exhaust the witness's knowledge as to what may make one or other of these conclusions probable.

Examination resumed: There is what is called the red oxide, which contains less oxygen than the black. A red heat only would convert the black oxide into red, and the same degree of heat would make it red-hot.

By Baron BRAMWELL: There could not be a red heat which would not unhydrate the oxide; if you make it red-hot it must be anhydrous.

By the ATTORNEY-GENERAL: I have read Mr. Laming's specification. It describes a method by which hydrated peroxide of iron may be obtained, mixed with chloride of calcium. For practical purposes, that is not the same thing as that described by Hills, because the chloride of calcium absorbs the hydrate and chokes the pores. It will absorb sulphuretted hydrogen to a certain extent, but it is very inferior as a purifying agent to the hydrated oxide. There is nothing in Mr. Hills' patent to indicate the presence of chloride of calcium. In Laming's patent it is the principal ingredient, the others are merely accessory; and his process is a method of making the chloride of calcium, which may be advantageous under certain circumstances.

The ATTORNEY-GENERAL having quoted from Laming's patent the paragraphs beginning—"Another part of my invention consists in the use of carbonate of iron," &c.; and—"To obtain these carbonates in an economical manner," &c.—inquired: Is the carbonate there spoken of carbonate of iron in its proper sense, or is it hydrated oxide of iron?

Mr. BOVILL submitted that this also was a question for his lordship.

The ATTORNEY-GENERAL: It raises a question for the Court of Exchequer—What is carbonate of iron?

Baron BRAMWELL: You must not suppose that the Court of Exchequer have decided anything.

The ATTORNEY-GENERAL: It decided to have a new trial, and here we are. (To witness:) Are carbonate of iron and hydrated peroxide of iron the same thing?

Witness: They are not. The directions here given would make a carbonate of iron, and not a hydrated oxide. Hydrated oxide has no carbonic acid to precipitate. These directions are to cause the salt of iron to exchange its acid for the sulphur in the gas liquor. I know perfectly well what was known as carbonate of iron in the druggists' shops. It has been for many years made in the same way. It is an oxide of iron, for the most part anhydrous peroxide of iron mixed with a variable proportion of carbonate of iron. It will absorb a certain portion of sulphuretted hydrogen, because by being exposed

to the atmosphere it contains a small portion of hydrated oxide; but it is not a material that could be used in the purification of coal gas, and it is not the article patented by Mr. Hills. Hydrated peroxides may exist in a native state, or may be artificially prepared; precipitated oxide must be artificial. In its original condition the oxide is in ore in hard lumps. There are several varieties of natural hydrated oxides; they are found sometimes pure, at others disseminated in large quantities of earth.

By Baron BRAMWELL: In what is called pure oxide there is no earth mixed. A large quantity of the brown hematite is found so, and that is one of the most valuable ores.

By the ATTORNEY-GENERAL: In order to resort to Mr. Hills' process, the hydrated oxide of iron must be in a pulverized condition; you could not take a single step in the process if it were in a hard mass.

Cross-examined by Mr. BOVILL: Some of the native hydrated oxides are found in a state of powder. Those will not purify gas, but there are some native hydrates that will. I made some experiments on these subjects before Mr. Hills' patent was taken out, but not with a view to ascertain whether they would or not. The two principal matters to be got rid of in the purification of gas are ammonia and sulphuretted hydrogen. Chloride of calcium is used for removing the ammonia, and muriate of manganese might be used for the same purpose. Muriate of manganese, if mixed with hydrated oxide of iron, would produce a similar slimy matter to that of chloride of calcium; they are both equally delequescent.

Baron BRAMWELL: Allow me to ask, is this with reference to either Croll's or Laming's patent?

Mr. BOVILL: It is with reference to Hills' alone. If your lordship will look at his patent you will find that he says: "I take the sulphates, the oxychlorides, or the hydrated or precipitated oxides of iron—which I prefer to use in rather a damp state, either by themselves or mixed with sulphate of lime, or sulphate or muriate of magnesia, baryta, strontia, potash, or soda—and absorb them into or mix them with sawdust or peat charcoal, in coarse powder or breeze, or other porous or absorbent material, so as to make a very porous substance easily permeable by the gas; this material is to be put into a purifier (such a one as is used for dry lime answers the purpose), and the gas is to be passed through it, whereby the gas will be deprived of its sulphuretted hydrogen, cyanogen, and a part of its ammonia, which will be absorbed into the porous material—water being at the same time formed by the union of the oxygen of the oxide and the hydrogen of the sulphuretted hydrogen absorbed." (To witness:) If you use hydrated oxide of iron and chloride of calcium together, would the effect be the same as using hydrated oxide of iron and muriate of magnesia?

Witness: Very much the same chemical effect would be produced. In the one case you get a salt of magnesia, and in the other a salt of lime.

Baron BRAMWELL: I am afraid we have now got a new group of muriates.

Mr. BOVILL: If your lordship will look at Laming's patent you will find that he says: "Chloride of calcium is both abundant and cheap, but under certain circumstances it may be desirable to make it, for the purposes of gas purification, by decomposing muriate of iron by means of lime, or of chalk when the latter will suffice. In such case the oxides or carbonates which result are useful for the said purification and need not be removed,"—and the line of examination here was to show that Hills' process was different to Laming's, because Laming used chloride of calcium with the hydrated oxide of iron, supposing the carbonate to be the same. I want to show that Hills pursues a course which is quite similar, except that he uses muriate of magnesia instead of chloride of calcium.

Baron BRAMWELL: You do not mean to say it would be the same thing because the produce is slimy?

Mr. BOVILL: No; the witness says the effect would be the same. My cross-examination is to show that Hills describes a process identical in effect, with regard to the purification of gas, to that of Laming.

By Baron BRAMWELL: The process described by Laming gives a correct result. It depends upon whether chalk or lime is used. If lime, it would produce hydrated protoxide. Chalk will not decompose it in a wet way; it requires the application of a high temperature, and then there would be an anhydrous peroxide.

By Mr. BOVILL: Mr. Hills' process does not produce hydrated protoxide. He says nothing about it. I will read it, and you will see that it is impossible. He says: "I take the subsulphates, the oxychlorides, or the hydrated or precipitated oxides of iron," &c., &c. He does not give any description how it is to be formed. I agree with the other witnesses that hydrated protoxide becomes peroxide by exposure to the air. By adopting the plan in Mr. Hills' specification (page 14, line 7), where he says, "Hydrated or precipitated oxides of iron may be conveniently prepared for these purposes by decomposing sulphate or muriate of iron with hydrosulphuret of ammonia, or with lime, magnesia, potash, or soda; they may then be absorbed into or mixed with sawdust, peat charcoal, or breeze, or other such material, and afterwards exposed to the air," you would produce a hydrated protoxide, so far as that goes, and mixed with hydrosulphuret of iron if you used hydrosulphuret of ammonia.

Mr. BOVILL: Your lordship will find that Mr. Laming says this material may be "made into a more porous material by being absorbed into or mixed with sawdust or peat charcoal; and either used alone or mixed with sulphate of lime or muriate of manganese, and in conjunction with any other purifying material;" and Mr. Hills also proposes to "absorb them into or mix them with sawdust or peat charcoal in coarse powder, or breeze, or other porous or absorbent material, so as to make a very porous substance easily permeable by the gas."

Baron BRAMWELL: Not having had the opportunity of hearing your speech so as to know what your views are, I want to see, if I can, what you are driving at. [His lordship having read his notes of the last part of the witness's evidence, said:] I wish an accomplished chemist had got to try this instead of me; I really do not understand it. Let us set seriously and reasonably to work to ascertain the truth of this matter, if it is of any consequence. As I understand it, what Hills has here described is how you may prepare hydrated or precipitated oxide of iron. I do not understand him to claim that mode of preparation, but merely that you may make it in that way if you cannot get it; and, as I understand Dr. Miller to say, the protoxide thus produced would be a hydrated protoxide of iron, but that that is not so good as a peroxide.

Mr. BOVILL: But it becomes peroxide by exposure.

Baron BRAMWELL: I am not quite sure that he contemplates that.

Witness: You cannot mix it and expose it to the air without its becoming so.

Mr. BOVILL: By the examination they say that Laming's is a totally different thing, because for this purpose—conceding that the oxide or carbonate which he describes is hydrated oxide—it is mixed with chloride of calcium, which is a delequescent or slimy matter, and therefore cannot be the same as Hills'.

Baron BRAMWELL: It may seem an impossibility, but the question is not for the Attorney-General to show that there is a difference, but for you to show that it is the same. Their conclusion may be a wrong one, but it is for you to make out a theory of similitude. Do I understand you to say, that this mixture of chloride of calcium with more or less of hydrated oxide of iron, if lime is used in the preparation, is the same thing as the matter described by Hills?

Mr. BOVILL: Yes, *qua* purifying gas, and also *qua* producing the same substance—hydrated protoxide of iron, which by exposure and use beco es peroxide.

Witness: Yes, if it is mixed with sawdust and exposed to the air.

Baron BRAMWELL: It produces oxide of iron—not *simpliciter*.

Mr. BOVILL: They none do.

Witness: It is always mechanically mixed with chloride of calcium.

Mr. BOVILL: Using that for the purification of gas, the hydrated protoxide of iron would affect the sulphuretted hydrogen, and the chloride of calcium would affect the ammonia.

Baron BRAMWELL: Stop. Am I to understand that that mechanical mixture would, without separation, become hydrated peroxide?

Witness: I stated that the presence of the chloride of calcium would greatly retard the process of oxidization by exposure to air, but if exposed sufficiently long it would do so.

Baron BRAMWELL: As children say, when Gog and Magog hear the clock strike one they come down to dinner.

Witness: I mean, if exposed for a considerable period the protoxide would become peroxide, but the presence of the chloride of calcium retards the operation.

Baron BRAMWELL: Now, I think, we understand Laming's patent. I shall strike out all I had about this before.

Mr. BOVILL: No; I think your lordship had it right then.

Baron BRAMWELL: I think I've got it righter now.

Cross-examination resumed: I have not made any experiments with Hills' patent, but as a chemist I can answer the question, that if you take muriate of iron with magnesia, as stated by him, you would produce hydrated protoxide of iron—not if you take sulphate. They are in mechanical combination, and if exposed long enough, that mixture would become hydrated peroxide. The change would be retarded by the presence of the muriate of magnesia, which, like the chloride of calcium, is a delequescent salt.

By Baron BRAMWELL: So that in the result you would have, if you waited long enough, hydrated peroxide of iron mechanically mixed with the delequescent salt, in the one case, of chloride of calcium, and in the other muriate of magnesia. The hydrated oxide in Laming's mixture would act on the sulphuretted hydrogen, and the chloride of calcium on the carbonate of ammonia. Each would act separately, because they are in mere mechanical combination.

By Mr. BOVILL: The operation of the plaintiff's process is an analogous one.

By Baron BRAMWELL: They are identical in their *modus operandi*, the only difference being that in Laming's case you get carbonate of lime and in Hills' the carbonate of magnesia.

By Mr. BOVILL: If absorbed into sawdust when exposed to the air, the protoxide becomes peroxide more rapidly. By the term soda in Hills' patent I do not understand carbonate of soda. The commercial name of carbonate of soda is soda ash. If you ask for soda at a chemist's shop they will give you, not carbonate, but caustic soda. This is a chemical patent, and must be construed plainly; and I think, from the context, the patentee has used the word scientifically. Caustic soda would be more expensive than carbonate, and would produce a different result. By its use in the first instance you would undoubtedly not produce a carbonate of iron.

By Baron BRAMWELL: There is no carbonate in caustic soda.

By Mr. BOVILL: If you use muriate of iron and caustic soda you would get a hydrated protoxide of iron, and if you used muriate of iron and carbonate of soda you would get a hydrated carbonate of protoxide of iron. Whichever you used the result would be that by exposure to the air the hydrated peroxide of iron would be formed, because the carbonic acid is driven away and the oxygen takes its place. Commercially, it would be a disadvantage to use caustic soda; and if this patent were put into my hand for the purpose of producing a hydrated oxide of iron, I should use the cheapest material.

By Baron BRAMWELL: If not required to follow this process, I should use lime.

Mr. BOVILL: And looking to the word "soda" here, you would use carbonate?

Witness: Yes, if you like.

Baron BRAMWELL: The two answers are perfectly consistent, Mr. Bovill. He says, if any one had shown this to me I should know that by a complicated process I should produce the same result; but if you ask me to put a construction upon this, I infer that the man who penned it did not know it.

Mr. BOVILL: You say if that were put into your hands, you, as a manufacturing chemist, would use carbonate of soda. Do you mean to say that you infer from this that Mr. Hills meant you might not use it?

Baron BRAMWELL: What can it matter what the specification is? What I would suggest would be, to have established the fact that carbonate of soda was the best form of soda for the purpose.

Witness: Carbonate of soda is not the usual expression for soda.

Mr. BOVILL: Suppose you use carbonate of soda, would you not then produce by the very process stated here what you have before described as a strict carbonate of iron?

Witness: Of course you would produce hydrated carbonate.

Baron BRAMWELL: Will you gratify Mr. Bovill by saying it is a strict carbonate?

Witness: It is a strict carbonate. It is the same carbonate as I spoke of in Laming's. I do not say that the whole of the *ferri carb.* bought at the shops was anhydrous. It contained about 2 per cent. I never prepared carbonate of iron in a dry state without its being hydrated oxide. I have never attempted to do it; it cannot be done—because in small quantities, by exposure to air, it becomes peroxide. The attempt to prepare it in a dry state was the origin of the mistake in the *Pharmacopœia*. If you go to a first-rate chemist's in London, such as Savory and Moore, or Bell, and ask for *ferri carb.*, you would not get hydrated oxide of iron. They profess to follow the *Pharmacopœia* in most cases, but not in this; if they did, they would get the hydrated oxide.

Baron BRAMWELL: Is sesqui-oxide a carbonate?

Witness: No, it is not.

Baron BRAMWELL: Then it bears as inappropriate a name as the old carbonate of iron?

Witness: Sesqui-oxide is the proper name for that which formerly was called carbonate of iron. It is the same as the peroxide. If you sent an order now to the best chemist's for carbonate of iron, you will get sesqui-oxide, because that is the proper description of it in the *Pharmacopœia*.

Baron BRAMWELL: You know that it is something like the interpretation of the law about leaving property to children. If there are any legitimate ones it goes to them; if not, to the illegitimate. If a chemist is asked for a thing which does not exist, he gives that which is known by the same name.

Mr. BOVILL: It is not so, my lord; and when we come to our evidence you will see that it is important.

Baron BRAMWELL: But is it not the fact because practically you cannot have it?

Witness: If I sent to a manufacturing chemist's and asked for true carbonate of iron, I should get it; if I go into a shop and ask for carbonate of iron, I get what is called sesqui-oxide.

By Mr. BOVILL: That is not the same as hydrated oxide, but I have bought some with as much as 25 per cent. in it. You could not at some chemists' get it almost wholly hydrated. I have not taken the trouble to go to some of the first chemists in London, and afterwards analyzed what I bought.

Baron BRAMWELL: If I understand, this is important with reference to Laming's statement—that he uses carbonate of iron, which you say may mean not true carbonate, but that which is popularly called carbonate, and which is hydrated.

Mr. BOVILL: Quite so; and more than that—you will find that he speaks of "oxides or carbonates."

Cross-examination continued: The cyanogen referred to in Hills' patent as in combination with the hydrated oxide is chemically combined. The porous matters put into the purifiers with it are only in mechanical combination. It was known as a chemical fact before 1849 that hydrated oxide of iron in mechanical combination with other things would absorb sulphuretted hydrogen. The reason that the oxide ceases to purify is, that it becomes mixed mechanically with a large quantity of sulphur. It absorbs each time, and each time it becomes decomposed; and it ceases to purify when it becomes choked up with the sulphur. The renovation consists in exposing it to the air, and thus enabling it to throw off the sulphur, which, however, is not got rid of, but is set free in the mixture.

Baron BRAMWELL: I suppose the iron having a greater affinity for the oxygen of the atmosphere than for the sulphur, and not being able to hold both, lets the sulphur go.

Witness: Yes, and the sulphur being a solid, and not a volatile body, it accumulates in the mass.

By Mr. BOVILL: Instead of taking it out and exposing it to the air, and so separating the sulphur, you can drive it off by roasting it at somewhere about the heat indicated by Dr. Taylor. It requires more than 700° or 800° to decompose sulphur, but somewhere about that will volatilize it. If you let in air at the time you are roasting, you can drive off sulphur at a lower heat. It begins to burn at a temperature of about 500°.

By Baron BRAMWELL: It would be assisted also by the oxygen affixing itself to the iron—an oxide would be formed, and the sulphur would be disengaged.

Mr. BOVILL: I find by a translation of the *Pharmacopœia* of 1851, that sulphur will sublime at 600°.

Witness: A portion of it will be converted into vapour, but you cannot distil it at that temperature. I know that is an error from my own experience. A small portion of it would be volatilized at 650°. The boiling point of sulphur is between 700° and 800°. Admitting air, you would get rid of the whole at a temperature of 650°. So long as you kept the roasting point below 900° or 1000°, the material would continue a hydrated oxide of iron; but I do not think that is a practical operation. It is very difficult to regulate a high temperature within 300°; you have no means of judging what it is except by colour. There are many operations in manufacturing chemistry in which you are obliged to keep up a high temperature, which is regulated by the admission of air. I dare say this might be done practically and commercially. It is seven or eight years ago since I first knew of Croll's patent. I knew of it before I heard of Laming's. I do not recollect whether I stated on the last occasion that oxides generally were claimed by Mr. Croll, but I have no objection to say it again. The term "oxides" implies both hydrated and anhydrous; it is a general term. I am not aware that they were previously used in the purification of gas; I state that to the best of my knowledge and belief. I will not swear that on the last occasion I did not say that "they were also previously known in the purification of gas."

Baron BRAMWELL: He may have said at that time what everybody else has said here, that it was known the oxide of iron would imbibe sulphuretted hydrogen.

The ATTORNEY-GENERAL: The principle was known fifty years ago.

Cross-examination continued: With my knowledge of the subject, if I had looked at Mr. Croll's specification I should have supposed that he meant such oxides as would absorb sulphuretted hydrogen. I should, therefore, in proceeding to roast it as he directs, have kept the temperature as low as I could to drive off the sulphur. Assuming, as I do, that in reference to the use of manganese it was to be heated to a red heat, I should consider that that could not be otherwise than anhydrous. I have tried with oxides of iron and manganese, which have been heated to a red heat, in my laboratory and at Mr. Hills', with gas obtained from the Deptford Gas-Works. I consider the direction to roast the manganese to a red heat is sufficient to prove that it must be anhydrous.

By Baron BRAMWELL: Oxide of iron which has been exposed to the action of sulphuretted hydrogen will become red by exposure to atmospheric air. Oxide of manganese would not do so.

By Mr. BOVILL: The whole of the oxide of iron will not become red in the furnace, because the mass is not sufficiently porous, but all the visible portion would be. It would make all the difference whether sawdust were mixed with it or not.

Re-examined by the ATTORNEY-GENERAL: As a scientific chemist, knowing that hydrated oxide will absorb sulphur and that anhydrous will not, if I had attempted the process spoken of by Mr. Croll, I should have used the former, but there is nothing in the specification to indicate to a person not well versed in chemistry which should be used, and I think he would take the anhydrous. Having gone through the first process of purification, the oxide would become anhydrous by making it red-hot, and would not practically effect further purification. During the nine years that intervened between Croll's patent and Hills', I never knew of hydrated or anhydrous oxides being employed for the purpose. There is nothing in Laming's patent about getting rid of the carbonic acid. Carbonate of iron will purify to some extent, but not to the requisite extent for practical use in gas-making. If there were enough of the hydrate in the substance to effect the purification, it could not be renovated, except by the process of Mr. Hills.

By Baron BRAMWELL: Hydrated oxide of manganese would absorb sulphuretted hydrogen very slowly—not sufficiently rapid to make it practically useful. The gas would have to be passed through more than once, or some other process must be adopted to get rid of the remainder. Exposure to the air after it had become saturated with the sulphuretted hydrogen, would produce an exactly similar result to that produced on hydrated oxide of iron. Exposure to the air without heat would be the better way than roasting it in an oven, because it would leave the oxide of manganese in a hydrated form. By subjecting it to heat. the sulphur would be more readily got rid of.

Baron BRAMWELL: By careful manipulation heat might be used and the oxide not unhydrated?

Witness: The oxide of manganese is not so difficult to deprive of its water as the oxide of iron, but I cannot speak from experience. I think you could not practically use heat without unhydrating it. The term "roasting" is a very indefinite term.

Baron BRAMWELL: Comparing the expression, "This material, after it has ceased to absorb the sulphuretted hydrogen, is to be removed from the purifying vessel and roasted in an oven to expel the sulphur which it contains," with the following, "After this material has become thoroughly red in the oven," &c.,—Does that, as applied to manganese, intimate such a heat as would unhydrate it?

Witness: Yes, because it cannot become "thoroughly red" without being exposed to a red heat.

Mr. BOVILL asked permission to cross-examine the witness on the learned judge's examination.

Baron BRAMWELL said: I think it must be evident to you that Mr. Croll says nothing particular about iron except that what is true of manganese is true of iron. The thing, therefore, to ascertain is, what he means with reference to the oxide of manganese. (To witness:) Have you made any experiments upon oxide of zinc?

Witness: I have not. There is a hydrated oxide of zinc.

Mr. BOVILL: If you used black oxide of manganese in the first place, as here stated, for removing the sulphuretted hydrogen, would not that when charged with the impurity become of a flesh colour?

Witness: I have not observed such a result in my experience. The hydated sulphuret of manganese is of a flesh colour.

Mr. BOVILL: Does that become red when roasted to 400° of heat?

Witness: I should think not, but I have not made the experiment. I should say that in the oxide of manganese there is always a quantity of oxide of iron present which prevents the flesh colour being visible when exposed to the action of sulphuretted hydrogen. It will turn to a red colour by heat, with an access of air at a lower temperature than is necessary to drive off the water.

Mr. BOVILL: Then how is it, when I ask you if it will turn red at a heat of 400°, you say you cannot tell me, and yet you are bold enough to pledge your opinion that it would require the same degree?

Witness: Because the red oxide is an anhydrous oxide; it is no longer sulphuret of manganese.

Baron BRAMWELL: Mr. Bovill assumes that it continues a hydrated sulphuret of manganese?

Witness: Certainly not, my lord; by heat it is decomposed.

Mr. BOVILL: This pink material, will it not turn red when roasted in an oven at a degree of heat some hundreds of degrees lower than a red heat?

Witness: I have not made the experiment; I do not know.

By Baron BRAMWELL: I do not know either way, but whatever heat it turns red at must have made it anhydrous, or it would not be red.

The ATTORNEY-GENERAL: I see in Croll's specification that he speaks of the black oxide of manganese; is it of that you have been speaking, or of the pure oxide?

Witness: Mr. Croll speaks of the black oxide, which is a mixture; I am speaking of the pure sulphuret of manganese, and not of the black oxide, as here represented. You do not find pure black oxide in nature.

Mr. *Alfred Upward*, examined by the ATTORNEY-GENERAL.

I am engineer at the Brick Lane and Curtain Road stations of the Chartered Gas Company, and have been so since 1852. I was bound to Mr. Croll in 1841 at the same works, Mr. Croll being at that time the manager of them. From time to time I saw experiments made by him with reference to the mode of purifying gas. I never saw oxide of iron used in any way. Mr. Croll continued at those works till 1844. In 1845 I was appointed deputy-superintendent of the Westminster station of the same company, and have continued in some office or other with them to the present time. To my knowledge, hydrated oxide of iron was never used or experimented upon until after the publication of Mr. Hills' patent. After that period, I believe it was introduced by Mr. Laming. That was about 1850, and we have continued to use his process to the present time, for purification and renovation, with effect, purchasing the material of Owen and Co., the licensees under the patent.

Cross-examined by Mr. BOVILL: The Chartered Gas Company have various stations, and of course experiments are continually going on at each. In 1841 we could not tell at Brick Lane what was going on at Westminster. We have not now the same process at all the works. I remember the experimental purifiers at Brick Lane. They were there, but not fixed, when I became a pupil of Mr. Croll. I do not know whether they had been used or not. There were only the old wet-lime purifiers besides. Since 1850 we have continued to use the material introduced by Laming; I believe it is an oxide of iron. It is black when taken out of the purifiers, and becomes red on exposure to the air. We have an apparatus for drawing air through it.

By the ATTORNEY-GENERAL: We take about sixty tons at a time, and that is divided into three separate portions, one of which is put into the purifiers. The gas is passed through it for two or three days perhaps, before taken out for the first process of renovation. When it is new it will go longer than when it is old. We then take it out and lay it upon sieves, so that every particle becomes exposed to the air, and it becomes renovated—at first it becomes red very rapidly, afterwards it takes more time.

Mr. *William Mann*, examined by Mr. CHAMBERS.

I am the engineer of the City of London Gas-Works, and have been so for eight or ten years. We have used Hills' process and materials at those works for three years. We have four purifiers, and sometimes in winter we purify 2,000,000 cubic feet of gas in twenty-four hours. This material effectually removes the sulphuretted hydrogen: the ammonia is removed by a previous process. Before the publication of Mr. Hills' patent I never heard of hydrated oxide of iron being used for the purpose of purification. In 1850 I went to Mr. Hills' works at Deptford with Mr. Church, who was our superintendent at the time, in order to form a judgment as to whether the process would answer for our company. I was satisfied with the operation, and with its effect, as far as it could be judged of from a small experiment. I have seen Mr. Croll's specification, and I think the roasting process he recommended would not answer commercially; at all events, it would be very cumbersome. I cannot tell whether his plan would be practically useful in a gas-work; I have no knowledge of the power of manganese, but the roasting process would be too cumbersome whatever the material employed. It would require that we should have furnaces for the purpose. I have seen Laming's patent of 1847. His carbonate of iron, if it could be used as a carbonate, would not be a good material, because we should have the carbonic acid from the iron thrown into the gas, and that would afterwards have to be

removed. As a practical man, I should say, having read his patent, that it would not answer for the purification of gas.

Cross-examined by Mr. LUSH: If you could use the carbonate of iron as such, the carbonic acid given off would injure the gas. I have heard chemists say that you cannot use it as such. I have never tried experiments with Laming's process, but I have seen them conducted at Deptford for the purpose of this trial. We do not use anything with the oxide according to Hills' process. We do not use sulphate of lime; we have used muriate of manganese to remove the ammonia. The porous material mixed with the oxide of iron is sawdust, I am told; but I never saw the material prepared. Before we used Hills' process, we never employed oxide of iron. We had some purifiers put up by a person of the name of Wright; I do not remember exactly when it was. They were put up by the company, not specially for the purpose of trying Hills' process, but for trying the best mode of purifying we could adopt. We have used lime and oxide of iron in them, but we never used any material in which iron was an ingredient until we used Hills' process, except as a matter of experiment by myself. In those experiments I used sulphate of iron, which would become an oxide. That might have been about a twelvemonth before—I question whether it was eighteen months.

Baron BRAMWELL: I wish to have my mind alive as to what you are addressing yourself.

Mr. LUSH: The use of oxides before they were employed by Hills.

Baron BRAMWELL: How does this bear upon the question that it was before Hills'?

Mr. LUSH: I shall show that from another source independently.

Mr. *Joseph Clark*, examined by Mr. HINDMARCH.

I am the engineer at the Imperial Gas-Works, Hackney Road, and have been so for many years. I remember an application being made to me by the plaintiff to try some experiments; also by Mr. Laming; the latter obtained permission in Feb., 1850, to purify the whole of our gas. He brought upon the premises some sulphate of iron or green copperas, and some breeze and sawdust, or something of that sort. A variety of mixtures were made with it from day to day, and they were tried in the small dry-lime purifiers. This went on for nearly a fortnight; and he tried several processes with cold and warm water and different quantities of the same material, but they all failed to purify the gas practically, though they did it to a small extent. It was a considerable time afterwards that Mr. Hills obtained permission to try experiments, for we were so disappointed at this proving to be only an experiment, which we had been told was a matured plan, that the directors were reluctant to give further permission. When Mr. Hills came, he brought material for twelve months' purifying of all our gas, and he went on doing it from that time most completely. The material which he brought, I am informed, was his patented hydrated peroxide. I never knew before of the use of oxides of iron for the purification of gas. I heard there were oxides in Mr. Laming's process, but before that I never heard of it.

By Baron BRAMWELL: Laming's material was sulphate of iron and a mixture of lime and sawdust. The green copperas was dissolved in water, and mixed with the lime and breeze; but I know nothing of chemistry so as to be able to speak upon it.

By Mr. HINDMARCH: We have continued to use plaintiff's process from the time he brought 1600 bushels on the premises, except for about six months, which we gave to Mr. Laming for another trial. We found that that was not equal to what had been previously done, so we abandoned it, and have kept to Hills' successfully ever since. On the second trial of Laming's the material came ready mixed, and had something of the appearance of Mr. Hills'. It did succeed to a great extent, but it was not equal to Mr. Hills'.

Cross-examined by Mr. WEBSTER: We used it at first for nine days or a fortnight, and Mr. Laming took it away because we could not go on any longer with it. There were some observations made at the time, arising from some difference between Mr. Laming and Mr. Owen, who were partners. I complained of Mr. Laming taking this sulphate away because it was going in a different direction to their works.

Mr. *Robert Munro Christie*, examined by Mr. POLLOCK.

From 1850 till 1854 I was the engineer of the Commercial Gas Company. I know Mr. Hills' patent process. It was first used in our works in 1853, and was found to answer. I have read Laming's specification, and have made experiments upon it, and have seen it tried at Mr. Hills' works, and I found that it did not purify gas like the plaintiff's. We heated the material to a low red heat, and afterwards it would not purify the gas. It would be possible to use the process upon a large scale, but it would be very expensive, and, in a commercial point of view, impracticable. Until Hills' patent, I never heard of oxide of iron being used in gas-works. I believe the same remarks would apply to Croll's process as to Laming's, and there would be the same objection to the roasting of the iron.

Cross-examined by Mr. BOVILL: I have tried muriate of iron and lime. It did not answer as we conducted the experiment. We mixed the iron and lime at a low red heat, and used it with sawdust.

Baron BRAMWELL: Is there anything about that in Laming's specification?

Mr. BOVILL: Not a word about it. (To witness:) Just tell me, when the experiment is properly conducted, do you mean to represent that the muriate of iron and lime will not purify gas?

Witness: I do not know; we did not try it so.

Baron BRAMWELL: You must be mistaken.

By Mr. BOVILL: I am not a practical chemist, but know sufficient of the subject for my profession. I went to see the experiments carried out by Mr. Hills, who sent for me to see what he did. I understood that we were following Laming's specification. I know what the effect should be—a chloride of iron and a peroxide of iron.

Baron BRAMWELL: But that is not so. It would be a chloride of calcium and a carbonate of iron. This gentleman cannot be right; he must be confounding the two processes.

By Mr. BOVILL: I tested the gas at Mr. Hills' before trying to purify it, to see whether there was any sulphuretted hydrogen present. It was tested with lead paper. I am not prepared to tell the jury that muriate of iron and lime will not purify gas. I have only tried it there as I have stated. The way we conducted it was by exposing the iron to a red heat, and by doing so we found it did not purify the gas. I did not try any experiment by simply mixing the two ingredients together, and allowing any decomposition to take place by the action of the atmosphere.

Baron BRAMWELL: It is no disparagement to this gentleman when I say he has tried it only in one form.

The ATTORNEY-GENERAL, referring to Mr. Laming's specification, said: You will find in half-a-dozen places a red heat is referred to.

Mr. BOVILL: Only when describing the preparation of one particular kind of oxide of manganese from carbonate of manganese.

The ATTORNEY-GENERAL: He is speaking of oxides in general, for he says, "I do not claim the exclusive use of any metallic oxide, but what I do claim is the combination for that purpose of the oxide of iron with the other purifying matters above indicated," &c.; and when he is describing the process by which the one oxide that he prefers is obtained, he brings it to a red heat, and I suppose these people thought they were to do it in the same way.

Baron BRAMWELL: This witness is speaking of dry muriate of iron and lime, and there is nothing about a red heat, or any heat at all, in connexion with that; therefore it seems to me that to try the experiment fairly you should have tried it hot and cold.

After some conversation on this point,

Baron BRAMWELL inquired of Dr. Miller,—Can you use dry lime and muriate of iron, as described in page 5 of Laming's patent, without applying heat?

Dr. *Miller:* You can; but the lime must be what is called slacked lime, which is a combination of water and lime.

Baron BRAMWELL (to witness): Was this slacked lime or unslacked?

Witness: I believe it was slacked lime.

Dr. *Miller:* Then it was not necessary; it would destroy the state of hydration, and therefore make it less liable to absorb sulphuretted hydrogen.

Witness, re-examined by the ATTORNEY-GENERAL: We made two series of experiments,—one about three weeks ago and the other about three months back,—and the result was the same in both cases. We decomposed the iron by means of chalk as well, and tried the *ferri carb.* and the precipitate thrown down by mixing iron in gas water. We did not try it with wet lime, nor did we try anything with manganese.

Baron BRAMWELL proposed to strike out the witness's evidence, but both parties requested that it might remain.

Mr. *Thomas Vince Barnard*, examined by the ATTORNEY-GENERAL.

I was the manager of the Deptford Gas-Works in 1848 and 1849, when experiments were being made by Mr. Hills. I think it was in the middle of 1848 when I had a pipe connected with our main for Mr. Hills to bring his apparatus and experiment upon our works. He sent in a small glass purifier, and passed the gas through it. His experiments were conducted a great number of times in 1848, and after that I carried a pipe on to his premises, which adjoined ours. I am quite sure that it was as early as the middle of 1848 when he began. The gas supplied to him was impure, as it passed through the condensers and before it came to the purifiers. I am quite sure it was in August, 1848. The material which he employed was of a chocolate colour.

Cross-examined by Mr. BOVILL: I have no doubt it was some material composed of sawdust mixed with iron. Mr. Hills continued to make experiments down to 1853. He took all the gas liquor we made. It was before the latter end of 1850 that we began to use the iron material at our works. I am sure that we used it in the middle of 1850.

By the ATTORNEY-GENERAL: I am quite sure that it was as early as August, 1848, that I first knew of experiments with a material of this colour, and which I suppose to be the same article. We were not in a position to use it in our works until some time in 1850.

The Rev. *T. P. Dale*, examined by the ATTORNEY-GENERAL.

I reside in London, and am a friend of the plaintiff. In the year 1848 I amused myself by assisting him in some of his experiments to find a purifier for gas. I think we must have begun late in 1847, or early in 1848; but I cannot charge my memory, as they were on my part only experiments by way of amusement, and I took little note of them. They continued down to the time when the patent was taken out, in 1849. We tried experiments with hydrated oxide of iron. We took some peroxide which we found would not work until it was hot, and then we burnt off the sulphur. The great difficulty was to find a substance which would purify gas over and over again. Mr. Hills showed me the difficulty overcome one day. I did not do it. It is very difficult for me to say when it was, but it was before the gas was laid on from the works, because we were trying the experiment upon some gas of our own. The experiments were conducted in a house in which acetic acid and naphtha were being distilled. It adjoins the gas-works, and the gas came through a hole in the wall. I can hardly charge my memory whether Mr. Hills had the assistance of any one else, who might have seen it. My visits were only occasional. As far as I know, he is the person who brought this process to perfection.

Cross-examined by Mr. LUSH: I can give no dates, except that it was anterior to the making of the hole in the wall. I do not remember when that was; that is my difficulty. The experiments were only made with hydrated oxides of iron; there were many of them. I saw the material exposed to the air and renovated.

By Mr. CHAMBERS: I am sure I saw that done, and that the same materials were used over and over again. It must have been in the early part of 1849 that I saw these experiments.

Mr. *James Murdock*, examined by Mr. POLLOCK.

I am a patent agent, and for many years have had great experience in these matters, and have been very often at the Attorney-General's chambers. I remember going with Mr. Hills in 1849. I do not remember whether he had any written account of his patent before he went, but he wrote one there. As far as I recollect he was asked to put down on paper what his invention was. I have seen a copy of that paper to-day. We might have been an hour or two waiting at the Attorney-General's chambers, but not longer after the paper was written than was necessary. It was not usual, unless the opposing parties requested it, to write down beforehand the nature of the invention.

By the ATTORNEY-GENERAL: I do not think it was by Mr. Hills' direction that the disclaimer of Mr. Laming was opposed. I was not engaged in that. It was upon his instruction that the proceedings took place upon both the *scire facias*.

Cross-examined by Mr. LUSH: I have taken out several patents for Mr. Hills. It was not usual to give a deposit-paper unless the opposing party desired it. The proceedings in opposition were always upon a caveat. We were opposed in 1849 by Mr. Carpmael. I cannot say whether I took out any patent for Mr. Hills in 1845.

The dates of the patents taken out by Mr. Hills were admitted.

Mr. *Thomas Hills*, examined by Mr. CHAMBERS.

I am the plaintiff's brother, and attend to the commercial part of the business at his works. I have been with him since 1848. I recollect the experiments made in that year for the purification of gas. I did not see them tried, but I passed by occasionally and knew they were being done, and the purpose for which they were made. It was about the end of 1848, or the beginning of 1849, that I first heard of the experiments for renovating the material. My brother was trying those experiments long before he applied for the patent. I was present on the occasion of the recent experiments, when Mr. Christie was there. We had Mr. Laming's specification before us, and, as far as I know, we attended to the course which he states. One experiment was tried with heat, and one without. One experiment was with muriate of iron, and another with lime—the muriate of iron was

dissolved and lime added to it. It was put into a small furnace, and a dull red heat applied. In the other experiment, muriate of iron was dissolved and hydrate of lime added to it. It was then mixed with sawdust, put into a small purifier, and gas passed through it. It purified the gas entirely from ammonia, but only partially from the sulphuretted hydrogen. I have seen that done many times. In the year 1849 I recollect my brother making some experiments at the Chartered Gas-Works, Westminster, for taking out the ammonia from gas with sawdust and water. A large round scrubber was filled with sawdust and wetted, and the gas passed through it, which took out the ammonia. We set to work on the 17th of July, and after the purifier was filled I was there a little more than a fortnight. After a day or two the wood-work which was placed inside to support the sawdust, gave way, and it had to be taken out, and it was finally set to work on the 28th of July. I visited the premises only three or four times after that—the last time being about the latter end of August. During the time I was there I did not see any part of Mr. Laming's experiments. I saw a good many purifiers there, but not those in which he was trying experiments. I saw Mr. Laming there one day, and Mr. Evans told me he was going to use Mr. Laming's patent, or had done so. He told me nothing more. Neither he nor any one else at that period communicated to me that any preparation of oxide of iron was being used, and I certainly never communicated to my brother any such thing. I think it was one day in August when I met Mr. Evans standing at the gate, that he told me about using Laming's patent.

Cross-examined by Mr. LUSH: I saw Laming at the works and many purifiers there, but it did not occur to me that experiments were going on. I had no idea, except from what Mr. Evans said, that they were using or were going to use Mr. Laming's patent. I saw some lime in the large purifiers, and also some stuff which they told me was phosphate of lime. I can positively state that I did not see any oxide of iron. I might have been at the works as late as October. I mean to say that Evans never told me they were using oxide of iron, and I never saw any there. The recent experiments referred to were made both hot and cold. Mr. Christie was there all the time. We used heat once with the hydrate of lime. Mr. Scanlan, who is a chemist, was there, and also Mr. Clark, Mr. Mann, and Mr. Patterson, our solicitor. These experiments took place three weeks ago, and also three months back. I mean to say that, however conducted, that process will not do. It takes out some of the sulphuretted hydrogen, but it is not practically useful, however mixed and used. We have tried it many times, but it will not answer.

By Mr. CHAMBERS: The model (of the Chartered works) does not correctly represent the premises. Those large openings were not there; I could not see through; and the wall was much higher. I saw the model produced at the former trial. I think it was different to this.

Baron BRAMWELL: Sufficient unto the day is the pleasure thereof. Why should we consider what the model used on the last occasion was? What can it matter now whether it was right or wrong?

Mr. BOVILL: But Mr. Chambers charges us with fraud in having a wrong model.

Witness, re-examined by Mr. BOVILL: The Chartered works are very large ones. When I was there and was looking for a thing to try the sawdust process in, Mr. Evans showed me two small purifiers, and I told him they were not nearly large enough. I did not see in them; they were closed.

Mr. *Joseph Wonfor*, examined by the ATTORNEY-GENERAL.

I am a manure merchant carrying on business in Dublin. I was formerly employed by Laming and Owen as an assistant, in 1850. Mr. Laming's experiments at the Imperial works were made before I joined him. He made some experiments at the Chartered works in 1850. He supplied a variety of materials, one of which was sulphate of iron and lime mixed with sawdust. They commenced in the spring of 1850, and at the time I went Mr Evans was going to turn out all the materials in consequence of their failure. All the attempts with the sulphate of lime failed. Afterwards there was this mixture of chloride of calcium and iron made, and that actually failed, while used exactly according to the direction in the specification. I cannot say whether Mr. Hills' patent process was tried there; his materials were used at many other gas-works. After being with Mr. Laming some time, I was engaged by Mr. Hills to conduct his process. In consequence of a dispute which had taken place between him and Laming, I went round to the various companies to introduce Mr. Hills' oxide One of the places was the St. Pancras station of the Imperial Company, and there it was carried on very successfully so long as I remained with Mr. Hills. Wherever I have known Laming's process to be used, it has failed; and wherever Mr. Hills' has been tried according to his specification, it has succeeded. I have had many conversations with Mr. Laming on this subject, but I never heard him say that he used the hydrated oxide of iron or the anhydrous. The latest time that I saw Mr. Hills' process tried was in October, 1851.

Cross-examined by Mr. LUSH: I went direct from Laming to Hills. Mr. Laming did not dismiss me. He charged me with communicating his secret to Mr. Hills, which was not the fact, and I said, if that was the case, I would not have anything to do with him. I did not know Mr. Hills, except that I had met him two or three times at the Westminster gas station when I was with Mr. Laming. I cannot say positively that I was there in 1849. I did not see Mr. Hills or his brother there at that time, that I am aware of. It would be hard to swear it, but certainly it was not frequently. It must have been in the autumn that I went to the Westminster works. I continued with Mr. Laming till the following year. I should not like to swear that I did not go in 1849, as I have been to so many places since. I have been in the service of the Apothecaries' Company since then. Whichever year it was that I went there, Mr. Hills was not making experiments there to my knowledge.

Mr. *Edward Owen*, examined by Mr. HINDMARCH.

I carry on business at Millwall as a manufacturing chemist, having succeeded my father in the firm once conducted by Laming and Owen. Laming left the business in September, 1854. Subsequently, my father carried on the business for some time with Mr. Mertens. We have carried out the practice of this invention, under the licence produced, to the present time. I also produce the deed of arrangement between the plaintiff and the former partners. We are in the habit of undertaking the purification of gas at gas-works. We do so at the Chartered and the South Metropolitan in London, and several in the country. We did so also at the Equitable till very recently, but they have now ceased. We do not get the material from the plaintiff; we make it ourselves, and pay a licence-duty to Mr. Hills in consequence. The quantity we consume is 300 or 400 tons per annum. I know Mr. Laming very well: I saw very little of him in 1849 and 1850, as I was not connected with the works at the time. I did not hear from him a description of the oxide of iron he was using.

William Ruff, bricklayer, and *John Johnson*, a labourer, formerly in the employ of the Chartered Gas Company, were called, and examined as to the alleged incorrectness of the model of the works produced, and to show that it was not possible for plaintiff, when experimenting at the scrubber, to see what was going on at the large purifier.

Baron BRAMWELL expressed a very strong opinion that this evidence involved a sheer waste of time, and said it merely disproved that the plaintiff *must* have seen, and proved that he *might* have seen, what was going on.

Some formal evidence was then given as to the filing of the plaintiff's disclaimer, and

The ATTORNEY-GENERAL said: That is the plaintiff's case, but there is some question about the evidence of Dr. Miller.

Baron BRAMWELL: Dr. Miller said very clearly that hydrated oxide of iron includes both natural and artificial, but precipitated oxide includes artificial only.

Mr. BOVILL: That is a question for the judge.

Mr. *F. C. Hills* recalled, and examined by Baron BRAMWELL.

At what time will you undertake to say this process of yours was perfected?

Witness: I purified and renovated by the end of 1848, my lord; but a great many times in 1849.

Baron BRAMWELL: When was it perfected?

Witness: At the end of 1848.

Baron BRAMWELL: How soon had you got the plan described in the specification?

Witness: By the end of 1848; but further experiments as to the best mode of applying it went on until the taking out of the patent.

Baron BRAMWELL: Then you were certain of the principle at the end of 1848. Why did you delay taking out your patent until the end of 1849?

Witness: I had a great many things doing, and I was trying other things, and I wished to include what I thought would be beneficial.

Mr. BOVILL: Now, I submit to your lordship that the plaintiff must be nonsuited. In the first place, let me call your lordship's attention to what the plaintiff claims by his specification. As it stands now, he says, "I take the sub-sulphates, the oxychlorides, or the hydrated or precipitated oxides of iron (which I prefer to use in rather a damp state, either by themselves or mixed with sulphate of lime, or sulphate or muriate of magnesia, baryta, strontia, potash, or soda), and absorb them into or mix them with sawdust or peat charcoal in coarse powder, or breeze, or other porous or absorbent material, so as to make a very porous substance easily permeable by the gas. This material is to be put into a purifier (such a one as is used for dry lime answers the purpose), and the gas is to be passed through it, whereby the gas will be deprived of its sulphuretted hydrogen, cyanogen, and a part of its ammonia, which will be absorbed into the porous material—water being at the same time formed by the union of the oxygen of the oxide and the hydrogen of the sulphuretted hydrogen absorbed." But without calling your lordship's attention to the precise terms, I say he claims two distinct matters—one the hydrated oxide of iron for the purification of gas from sulphuretted hydrogen, and the other the renovation of the material so employed for the purpose of purification. Now, my lord, so far as regards the first part of that claim, viz., the use of the hydrated oxide of iron, of course if any other person has previously published to the world under any general term which includes that, a method of purifying gas, his patent would be bad. But when we refer to Mr. Croll's patent, he distinctly states that the effect may be produced by the application of this oxide of iron. I have got it both from Dr. Miller and from Dr. Taylor, and there has been no contradiction from other witnesses, that "oxides of iron," as a general term, includes sufficiently for any purpose hydrated oxide of iron. I have further strengthened the evidence on that point by the proofs given by Drs. Taylor and Miller that it was well known by practical and scientific chemists in 1840, that hydrated oxide of iron possessed the property of absorbing sulphuretted hydrogen. It is not necessary for the purpose of this objection to know whether it was known that it absorbed it to a considerable extent, nor is it necessary to discuss whether Croll had specified hydrated or anhydrous oxides; but it is clear that he has claimed and given to the public the information that in 1840 gas might be purified by oxide of iron. It would appear also, looking to the state of the evidence, and according to the statement of Dr. Miller, that having that specification in hand, any man of ordinary scientific information would have tried the hydrated oxide in the first instance. If that were so, then there was a statement given to the world as plainly as could be, that oxides of iron, including hydrated and anhydrous, would purify gas from sulphuretted hydrogen. Upon that ground, therefore, I submit that upon Mr. Croll's specification the first part of the plaintiff's claim cannot be maintained.

Baron BRAMWELL: It might not be inconvenient to take your objections one by one. There is a double question raised by this—viz., first, whether upon the evidence Croll does indicate the use of hydrated oxide of iron? and next, assuming that he does, inasmuch as the plaintiff's use of it must be looked at as a whole, whether that would be any novelty? I do not know what the Attorney-General thinks of that, but it appears to me not unreasonable that either of you should have, if necessary, leave to move.

The ATTORNEY-GENERAL: My lord, I am perfectly content. No doubt, upon a patent like this, it is quite impossible to deny that every arguable point of law may be raised, and I never oppose myself, on the suggestion of the court, to a course which is convenient for both parties—viz., that the point once understood should be reserved and carried to a court of appeal.

Mr. BOVILL: Your lordship will, perhaps, hear all my objections; and if opposed to me, that is the course I shall ask to be taken.

Baron BRAMWELL: I will hear them. As far as my deciding here goes, I should do it without the least fear of the consequence; because if it turns out that I am wrong, I shall neither be surprised nor vexed, except for the sake of the parties who would have for the fourth time to try this case.

Mr. BOVILL: I should have no objection to that.

Baron BRAMWELL: But really if I propose this, it is in the interests of the parties. I will hear your objections through, and perhaps you will be content by indicating them at first, and then I shall know what they are.

Mr. BOVILL: I ought to say, in reference to what fell from your lordship with reference to combination, that Hills puts them as two distinct claims, which will give rise to remarks afterwards; and he must stand or fall upon them, as if either of those claims is not new his patent fails.

Baron BRAMWELL: So you say.

Mr. BOVILL: The next objection I take is with reference to Laming's specification. Applying that to the purification of gas from sulphuretted hydrogen, I shall be prepared to prove that Mr. Hills shows precisely the same material, precisely in the same way, and producing precisely the same results. The evidence, as it stands, shows that Laming describes the use of muriate of iron and lime for purifying gas, and that Hills describes the same thing

for the same purpose, and that both produce the same result. I am prepared to follow the specifications through in reference to the various things which are common in the two patents, but I take these two as illustrations because they are precisely identical. The same is true with reference to gas liquor, which throws down hydro-sulphuret of ammonia and the magnesia and other things, which of course fall under the same class of objections. Then, my lord, I come to one more definite, and which has been thrown out in bold relief in the course of the case, and that is, the use of carbonate of iron. Take it in the sense in which they use it—they say that Laming describes the use of a strict carbonate of iron—Hills also, by speaking of muriate of iron and soda, describes a matter which would produce a strict carbonate of iron in the sense in which they use it. The next objection with reference to the carbonate of iron is, that, combining the evidence as it stands, the use of that material by Laming must be treated as the use of that which was commonly known as carbonate of iron, and which is, in effect, hydrated oxide, and so the same as that employed by Mr. Hills. Then, my lord, some observation was made, that by his process Mr. Laming does not get pure oxide; but the same objection applies equally to Mr. Hills, that he does not.

Baron BRAMWELL: How so?—where does that appear?

Mr. BOVILL: Upon the evidence of Dr. Miller. He says that by the process which Laming describes, he would not get a pure oxide, and upon cross-examination he says Hills' would not.

Baron BRAMWELL: That is a branch of the third objection over again. I understand you to say, that by the plaintiff's process of using soda he would get a chloride of lime mixed mechanically with hydrated oxide of iron?

The ATTORNEY-GENERAL: With carbonic acid; and if he did not go on to the rest of the plaintiff's process, no doubt it would be so.

Mr. BOVILL: Also, as regards Laming, that he does not confine himself to simple carbonates, but in his specification, having described amongst other things muriate of iron and lime, he says: "In such cases the oxides or carbonates which result are useful for the said purification, and need not be removed;" and therefore he does not confine it to strict carbonates, but claims oxides as well, or rather, I should say, mentions them, for he would not claim them, as Croll had already done so. Then, my lord, there is also this: that Mr. Hills in his patent claims the use of these things, and "prefers to use them in rather a damp state;" and Mr. Laming has also said, "for which purpose I damp it," &c.

Baron BRAMWELL: That only shows that they are not dissimilar; it does not show that they are identical more than you have pointed out.

Mr. BOVILL: No, I do not know that it does. The next ground for a nonsuit is, that the application of hydrated oxide of iron for the absorption of sulphuretted hydrogen was well known, and that the application of it, with or without other matters in mechanical combination, could not be the subject of a patent as applied to gas. The late case of *Aston* and *Brooke*, in which a gentleman had a process for softening cloth, is a case in point.

The ATTORNEY-GENERAL: That was the case of a machine.

Mr. BOVILL: A machine for producing a hard and firm substance to thread, and which he also used to produce a soft texture to the surface of cloth, and the Court of Queen's Bench decided that it could not be the subject of a patent.

Baron BRAMWELL: I think the plaintiff got a verdict.

Mr. BOVILL: Yes, and it was afterwards set aside on the ground that the patent was bad.

Mr. HINDMARCH: In the first instance it was applied to cotton thread, and in the second to woollen threads, and the court decided that it could not be the subject of a patent as applied to linen.

Mr. BOVILL: There is another case—the application of hydrate of lime to sewerage water, which, though it had never been so used before, it was known to chemists that the hydrate possessed the property of precipitating matters held in solution in water. Nobody, however, had so applied it, and a patent was taken out. The plaintiff obtained a verdict down at Hertford, but the court set it aside on the ground that the patent was bad.

Mr. HINDMARCH: Quite the contrary; the patent was a good one, but there was no evidence of infringement to go to the jury.

Mr. BOVILL: No—that it could only be supported as a patent for manufacturing manure, and not as a patent for this purpose. Then, my lord, also, with respect to the process of renovation or reviving this material. It was a known chemical fact before the date of this patent, that hydrated oxide of iron charged with sulphuretted hydrogen, and thus becoming sulphuret of iron, would be restored to a hydrated oxide by exposure to the air. The mere application of that fact to the manufacture of gas cannot be made the subject of a patent, and this patent therefore is bad from the way in which it is taken out. Your lordship will observe that, with regard to that part of the patent, it is simply and purely a patent for exposing sulphuret of iron to the action of the air. For this reason it is that Sir Fitzroy Kelly tried to mix it up with chloride of calcium, to show that though hydrated oxide of iron might be so restored, yet, as this material was mixed up with other things, it might not have been previously known that the action of the atmosphere would have that effect. But my learned friend has forgotten this: that Hills, in his specification, claims the hydrated oxide of iron either with or without the other substances, and with or without porous materials. Therefore, as he claims it here, it is simply and only a patent taken out for repeatedly renovating or reinstating certain purifying materials, that purifying material being hydrated oxide of iron, which was a thing perfectly well known at the date of this patent. There is no connexion with gas in this part of it, except that it is found in a patent that relates to gas. Now, my lord, the next objection, which is of a different class, is to the specification; and I contend that it is bad because in it he claims all hydrated or precipitated oxides of iron, just as he says Mr. Croll claims it.

Baron BRAMWELL: Ah! that makes the question proposed to be put to Dr. Miller important.

Mr. BOVILL: The evidence of Dr. Miller was, that some natural hydrates will not do so—that the public would have to make experiments to ascertain what hydrated oxides would answer, and what would not. Then the next thing is this: an objection arises upon the evidence we have heard during the last hour or two, especially from Mr. Thomas Hills, who tells us that muriate of iron and lime, according to the experiments which he has made, will not work; and that is one of the things which the plaintiff describes. Now, if we take the plaintiff's evidence that it will do, then the process is Laming's; but whether it will or not, it is part of the process which he describes; and if it will not (according to the evidence of Mr. Thomas Hills), then he has, by his specification, described a process which will not answer; his own witness says it will not. The next objection is one which was taken on the last occasion, viz., that the specification, as it now stands, is not within the original title of the patent. The patent, as it now stands, is simply for "An improved mode of manufacturing gas;" but in the specification he has claimed, as a separate and distinct matter from the purification of gas, a process for obtaining the materials for the purpose of purification.

Baron BRAMWELL: Where is it?

Mr. BOVILL: It is the reviving process. The point which arises is this: he claims it as the separate subject of a patent, the repeatedly renovating the purifying materials by the action of the air, so that they may be used over and over again for the purpose of the purification of gas. Then the next objection is with reference to the disclaimer, having taken out his patent originally, and specified in the way which he has done, "For compressing peat for making fuel or gas, and of manufacturing gas, and of obtaining certain substances applicable to purifying the same," which is all stated distinctly. The objection taken by the Lord Chief Baron himself was, that his attempt to strike out all the rest, and leave the words, "an improved mode of manufacturing gas," gave it a wider signification than that which was originally stated; and if he can make that out, then his specification, as it stands upon the disclaimer, would not be authorized by the Act of Parliament, because the Act does not allow him to claim something more extended than the original specification, or to put in anything which, as it stood originally, would not have been allowed him. For the purpose of the disclaimer, you must look not only to the title of the patent, but to the specification as originally filed, and which is before your lordship. Looking at that, the Lord Chief Baron, on the second day of the last trial, said: "I did not observe till this moment in what manner the title had been altered. I have been looking about to see how that is stated, and I find that all the anterior part, 'an improved mode of compressing peat for making fuel or gas, and of manufacturing gas, and of obtaining certain substances applicable to purifying the same,' is entirely disclaimed. 'An improved mode of compressing peat for making fuel or gas,' is turned into 'an improved mode of manufacturing gas.' I shall not stop the case now, but I am doubtful whether any one has a right so to disclaim."

Baron BRAMWELL: Your point is that, if the patent had been originally for an improved mode of manufacturing gas, the interposition of the other parts of the title might have been maintainable, but the latter part of the title being struck out, the second part of the claim should be struck out, because the specification is now larger than is comprehended in the title?

Mr. BOVILL: Yes, my lord; that in reality the disclaimer is not within the Act of Parliament. These are the points to which I propose to call your lordship's attention in order.

Baron BRAMWELL: Have you any—the slightest hope that I could possibly decide this case here, so that it would never be heard of again?

Mr. BOVILL: No, my lord; I am quite satisfied of that, whichever way you decide.

Baron BRAMWELL: Then do you wish me to express an opinion merely for the purpose of having it reviewed, if it is not in your favour?

Mr. BOVILL: What I said is, that I shall be prepared to ask your lordship's opinion, and to act upon it without going further into the case; and, if your lordship should think the plaintiff should not be nonsuited, I am prepared to go on.

Baron BRAMWELL: In one sense, I have no right to decide against these objections till I have heard you and the learned gentleman on the other side, and then you in reply. Do you wish me to do that?

Mr. BOVILL: I would rather leave myself in your lordship's hands.

The ATTORNEY-GENERAL having expressed himself to the same effect, some further conversation ensued, at the close of which

Baron BRAMWELL said: I am of opinion that many of these points involve questions of fact for the consideration of the jury; and I am of opinion that if they did not, I ought not to stop the case upon any one of them. Without saying anything more about it, I think I shall, as a matter of law, decide all of them against the plaintiff, by giving the defendants leave to move upon each and all of them.

The ATTORNEY-GENERAL: I am quite content with that course.

Baron BRAMWELL: Then I will say: Objections overruled—points reserved.

Mr. BOVILL then proceeded to open the case for the defendants. He said: May it please your lordship,—Gentlemen of the jury, I am afraid, from the number of points which I have submitted to the court, you must be prepared for rather a long investigation into the circumstances of this case; and I cannot but think that when a matter of this sort is presented for the consideration of a jury, they naturally must have great difficulty in dealing with a question depending so much upon scientific and technical knowledge, in which for the first time, probably, several of you must be initiated into some of the mysteries of that branch of chemistry, and where great portions of your time must be occupied in learning that upon which your judgment has to be asked. It is a great satisfaction to me to know that there are several of the gentlemen upon the jury to whom matters of this kind are not entirely new. But in discussing a question of this kind it is necessary and essential that we should go back from time to time to the very origin of the thing, and pursue our inquiries step by step in order to attain to a proper appreciation of the discovery which has been made, and of which the plaintiff claims to be the inventor. I regret that, in the course of the case, my learned friends on the other side, and especially Mr. Chambers, should have felt it right to bring against the company which I have the honour to represent, a charge not in terms, but if the evidence means anything, a charge of having placed before a special jury of the county, by their agents, counsel, or attorneys, a false model for the purpose of deceiving that jury. If I was astonished in the onset at such an attempt being made, I am now the more astonished that my friend Mr. Chambers, by his nod of assent, repeats that charge against my clients. It is as false and as groundless as the claim of Mr. Hills to this invention; and I will take care that that model shall be proved to your entire satisfaction, even if it should involve the necessity of bringing every man from the works at Westminster. Gentlemen, you shall have evidence that it is not a false and fraudulent model, and that the company which I represent stand before you not as persons who are fraudulently endeavouring to deceive you, but as persons coming into a court of justice with true and correct evidence to ask your verdict upon it.

Baron BRAMWELL: You say it is suggested that your attorney is responsible for an unjust model. I do not think Mr. Chambers would say so, and, at all events, he would find it difficult to persuade me that Messrs. Rogers would ever do anything of that character.

Mr. BOVILL: Long before the jury have heard the evidence, they will be satisfied that there is no pretence for the charge. The plaintiffs bring here two old drunken discharged servants, who never saw the model till it came into court, and they ask you to say, upon their evidence, that we have made a fraudulent model in order to deceive the jury. If such remarks or observations were allowed to remain unanswered, and you were to enter upon this investigation with your minds poisoned against the company by suggestions of this kind, it is impossible for you to do justice between the parties; and it is for this reason that I have brought the matter before you. And, after all, the subject is of the least importance, as you will see in one

moment, except as they see some considerable importance in it. The question is this: This scrubber, it is admitted, was used by Hills in his experiments; it is admitted that that opening was there by their own witnesses; and what I propose, and what I shall be able to prove to you is, that Hills had an opportunity of seeing something here; but as the case goes on, you will find it is perfectly immaterial, and that the charge of fraud against the company is a perfectly idle one. Gentlemen, you have before you Mr. Hills' claim to be a patentee, and also to be entitled as the inventor to an invention—first of all, for purifying gas from sulphuretted hydrogen by means of hydrated oxide of iron, and also, as a separate and distinct claim, an invention for renovating that oxide from the sulphur which it imbibes in the course of manufacture; and the matter which you have to consider is, whether either or both of these things was known before the date of his patent in 1849. Now it is quite clear, from the evidence of Dr. Taylor, of Guy's Hospital, that it was well known to persons acquainted with these subjects, and it is only the knowledge of such persons that is material at this time. It is not necessary that all the world should know of the invention before the date of the patent. You might think that you had discovered an invention which was perfectly new, but when you went into that particular branch of trade in which science was brought to bear upon it, you might find that it had long been known, and the consequence would be, that you could not take out a patent for it. So that you have to ascertain what is the state of knowledge in the particular department cognizant with matters of that description, before you can make application for a patent. Now, here we have a matter which relates to chemistry, and which must therefore be judged of by the knowledge and experience of practical chemists. Dr. Taylor—who, I believe I may say, stands at the head of his profession—tells you distinctly, and Dr. Miller accords with him, that long before 1840 it was known that hydrated oxide of iron would absorb sulphuretted hydrogen. I am not sure that Dr. Miller went as far as Dr. Taylor; but I think you will be of opinion that you would rather take the clear, dispassionate testimony of Dr. Taylor, even if it were at variance, which it is not. But you have it as a fact from experienced men, who tell you that prior to 1840 it was known in science—well known to chemists, and they refer you to Berzelius and other books to prove it—that hydrated oxide of iron would absorb sulphuretted hydrogen. Well, now, the first part of the claim made by the plaintiff is for the use of this hydrated oxide of iron for this purpose, and for nothing else. My lord will find that, although Mr. Hills goes through a long process of describing how it may be made and with what it may be mixed—and he tells you that you may use it with one thing or with another, which he mentions; that you may use it with or without porous materials, and either in a damp or in a dry state—yet the whole claim is made to depend upon this: and if any one uses it, he insists upon his right to stop them under the claim in his specification. The words are perfectly clear; he says he claims the use of "the precipitated or hydrated oxides of iron, or the sub-sulphates or oxychlorides of iron, from whatever source obtained, either by themselves, or, which is much better, made into a more porous material by being absorbed into or mixed with sawdust or breeze, or peat charcoal in coarse powder, or other porous or absorbent material, so as to be readily permeable by the gas, and either used alone or mixed with sulphate of lime, or sulphate or muriate of magnesia, potash, or soda, or in conjunction with any other purifying material at present in use for a similar purpose." Now, that it was perfectly known before 1840, you have Dr. Taylor's and Dr. Miller's testimony; and, though it was never applied before to the purification of gas, I have submitted to his lordship, and do again through my observations to you, that that alone would prevent his having a patent; but, as this is a matter of law reserved, I will not make any further observations upon it. Then comes the next question,—Did any one before 1849, when Mr. Hills took out his patent, tell the world that they might apply this material in the purification of gas? Why, here's Mr. Croll, who in 1840 takes out a patent, and specifies it for "Improvements in the manufacture of coal gas, and in applications to remove or free coal gas from sulphuretted hydrogen." It being known that hydrated oxide of iron would take up sulphuretted hydrogen, granting for the moment that no one had applied it to gas, and that any one having applied it might take out a patent—which I deny, in law—then comes the question whether, in 1840, Mr. Croll did not tell the world that hydrated oxide of iron, which it was well known would take up sulphuretted hydrogen, would also take it out of gas. Why, here's his patent! Having described a process of purification by the use of manganese, he then says, "The same effect may be produced by the application of the oxide of zinc and the oxides of iron, and treated in the same way as above described." Now, gentlemen, it appeared to me that that was more a matter for my lord than for you; but it is one of the questions upon which his lordship thinks I should address you.

Baron BRAMWELL: Yes, it is; perfectly so.

Mr. BOVILL: Looking, then, at the fact that it was known that hydrated oxide of iron would take up sulphuretted hydrogen, here was a statement made by a man in the gas trade, acquainted with the manufacture of gas, in which he tells the world that the oxides of iron may be applied to purify gas from that impurity. That is the object of the patent; and Dr. Miller, notwithstanding his examination in chief upon this part of the case, at last, and after he had given you and me the trouble of half-an-hour's cross-examination, was forced to admit that if he were told to use oxides of iron for the purification of gas, with his knowledge as a chemist he would have used the hydrated oxide, after reading the specification of Croll's patent. Now if that is so, and you have it as an admission from no very friendly or willing witness, then it is precisely the same—Mr. Croll having published this to the world—as if he had said, I tell all you gentlemen who know that hydrated oxide of iron will take up sulphuretted hydrogen, that if you apply it to gas you will also from gas take it away. Now Mr. Croll, in another part of his patent, after speaking of getting rid of the ammonia, says, "It is proper here to state, that after the gas has been submitted to this process, it should have a further purification in order to free it from the remaining portion of sulphuretted hydrogen, which purification is to be effected by means of the oxides hereinafter described, or, in the ordinary way, by the use of lime." And when he comes to the oxides they are "the black oxide of manganese, the oxide of zinc, and the *oxides* of iron." According to the evidence of Drs. Taylor and Miller, "oxides" includes hydrated and anhydrous, and the consequence is, that with the competent knowledge which chemists are understood to possess, this is a telling of the whole world acquainted with chemistry and the manufacture of gas what they may do, and chemists will take the hydrated oxide for the purpose. Now, gentlemen, if you take that view of the matter, there is an end of the case altogether; because it is not necessary that both parts of this patent should fail. If that one single claim which he makes to the use of hydrated oxide of iron is not new, it defeats his claim. For, let me tell you, if he chooses to put forward as a separate and distinct claim a claim for the use of hydrated oxide of iron, and if that patent is allowed to stand in that form, he prevents any person or company from using hydrated oxide of iron for taking sulphuretted hydrogen out of gas; and therefore the law says, if you choose to put it in this way your patent must stand or fall by that, and unless the use of hydrated oxide be new, the patent cannot be taken out. And you will see the importance of this. Mr. Croll, knowing that hydrates will purify, says, in 1840, you may produce the same effect as with oxide of manganese by the use of oxides of iron. If you, by your verdict, should affirm that the plaintiff's invention is new, from that hour Mr. Croll himself would be prevented using oxides of iron, although he, by his patent of 1840, tells the whole scientific world that this is the article. Now, how is this attempted to be met? As it stands upon that, I submit to your better judgment that it is perfectly clear the thing was not new as a general principle of chemistry, nor new as applied to the purification of gas. Bear in mind also that the process of renovation, though said to be combined with it, is a distinct claim which must, like the process of purification, stand or fall by its own intrinsic novelty. How does the Attorney-General endeavour to get rid of this invention of Croll's, and the fact of the previous state of knowledge with regard to the hydrated oxides? Why, he calls three or four witnesses, scientific men, who say: "If I read this down to a certain point where it describes that the substance is to be used for the absorption of sulphuretted hydrogen, and after it has ceased to absorb is to be removed, I should certainly infer that it was to be a hydrated oxide; but when I find it is to be heated till thoroughly red, I understand that to be a red heat, and not a red colour; and understanding it so, it would then become anhydrous without water in its composition, and therefore I assume that Mr. Croll means an article which would not purify gas." Now, first examine the evidence, and settle the difference between Dr. Miller and myself. Dr. Miller says when I pointed to this passage that he understood a red heat; and yet, when I put the question to him, he says—"With my knowledge as a chemist, I should have used hydrated oxide." But the process here stated by Mr. Croll in no place says that the material is to be heated to a red heat. What he says is, that it is to be roasted in an oven to expel the sulphur, and, after having become thoroughly red, it is fit for use again. Now, bear in mind that this process of expelling the sulphur from sulphuret of iron is a thing perfectly well known to chemists; and Dr. Miller is obliged to admit that sulphuret of iron put into an oven open to the air, will give off its sulphur partly by the action of the air, and that it will sublimate or pass into vapour at a heat of 650°, and that anything between 650° and 900° or 1000° will do so, and yet leave the substance a hydrated oxide, and that it is not till it attains a temperature of 900° or 1000° that the mass parts with a particle of its water, which is held in chemical combination with it. Therefore, I do not care what Dr. Miller tells you,—here you get the substance. Practically, he said you cannot do it; but at last he was obliged to admit that it is done in every department of art in which it is necessary to regulate heat between 650° and 900°. If that is so, I should like to know why on earth you are to assume that Mr. Croll means an anhydrous oxide, which, they say, will not purify. Then, again, Dr. Miller, in answer to a question from my lord at the close of his examination, spoke of the black oxide of manganese, and of its becoming red only at a red heat. From first to last, he only gave you the information that black oxide of manganese does not continue black; that it changes to pink—that is to say, if it is pure oxide of manganese that is the effect. What the effect would be with gas he does not know, as he has not tried it; but he knows, as a chemical fact, that if you take black oxide of manganese, and allow it to absorb sulphuretted hydrogen, it becomes of a pink colour.

Baron BRAMWELL: You are wrong there. He said: "I do not know that it will become of a flesh colour when it absorbs from coal gas. Charged with sulphur, it becomes of a flesh colour; but at what heat it would become red, I cannot tell, but it would be at a heat that would render it anhydrous.

Mr. BOVILL: I am obliged to your lordship. Gentlemen, I shall supply witnesses on that point, and throw a little more illuminating power into the gas; and amongst other things I will prove, with reference to this oxide of manganese, that though heated to a red heat, it has been used over and over again for the purpose of purifying gas. So that, taking it upon their own showing that Croll claims anhydrous oxides only, I will meet them on that ground, and prove beyond all doubt that they may be used for the purpose. I will prove before you also that at the Liverpool Gas-Works they have used hydrated oxide of iron, that they have then exposed it to a red heat, and having got rid of the sulphur, they have used the material over and over again. I do not care whether that makes it anhydrous or not, for this reason: if their witnesses are right that anhydrous oxides will not purify, I say that if they use this roasting process, and bring it to a red heat, and still purify, it either shows that, if it becomes anhydrous, that anhydrous oxide will purify, or that you may bring this sulphuret to a red heat, and thus get rid of the sulphur, and yet not destroy the state of hydration or the purifying power of the oxide of iron. Besides that, I will prove to you beyond all doubt, on his own testimony, that in 1840 Mr. Croll used the very substance which Mr. Hills puts into his specification and now claims as his invention, and that too, not on an experimental scale, but for purifying thousands of feet of gas a day. He did not use it afterwards, because, as you are aware, improvements were taking place hour by hour in the manufacture of gas, and sometimes it is more advantageous, in consequence of the facility of getting materials, to use one plan than another; but that this system of using hydrated oxide of iron was in operation in 1840 will be clear upon the evidence of Mr. Croll, and also that he has stated it to the world in the specification of his patent. There is no doubt that with respect to the roasting, that is not so good a plan of renovation as the exposure to the air; but I am dealing now not with the system of reviving the material, but with the claim which the plaintiff makes to the sole and exclusive right to the use of the hydrated oxide of iron; and if I succeed in establishing the fact that this principle was well known to the scientific world, and that it was stated by Mr. Croll to be applicable to gas, and was thus used by him in 1840, I submit that that will be sufficient to destroy the plaintiff's claim to novelty, even though Mr. Croll had not taken out a patent so far as regards this part of the invention.

THURSDAY, AUG. 12.

Mr. BOVILL resumed his address, and having recapitulated portions of his argument, proceeded to say that if the plaintiff, instead of claiming the exclusive use of hydrated oxide of iron, had confined his patent to the system of renovating the material by exposure to the air, there would have been no objection to it so far as Mr. Croll was concerned; and now, if the defendants were not prepared to meet him, he might be able to support his claim. But in 1849 he had put forward two claims, the effect of one of which would be, if successful, to deprive Mr. Croll of the right to use that process which years before he had stated to be applicable to the purification of gas. He (Mr. Bovill) would now proceed to call the attention of the jury to the invention of Mr. Laming, which claimed, in the most clear and distinct terms,

"the use of carbonates of manganese, iron, zinc, and lead, for the purification of coal gas." What was understood by carbonate of iron? According to the evidence of medical men, if you went into a shop any time subsequently to 1836, and asked for carbonate of iron, you would get hydrated oxide. But he would not rest the case simply on the evidence of Dr. Taylor.

Baron BRAMWELL: I really must correct you. What Dr. Taylor tells you is this: "If you go into a shop and ask for carbonate, you get a preparation of iron which would have more or less of hydrated oxide in it. The largest quantity I have known is 25 per cent., and I have known as little as 2 per cent. What is generally found in the shops is not hydrated."

Mr. BOVILL said those minute differences would not become material for the plain reason that the carbonate of iron was what Mr. Laming stated. He said: "Another part of my invention consists in the use of the carbonate of iron for the purification of coal gas."

Baron BRAMWELL: I must read you the last remark of Dr. Taylor in his examination in chief:—"*Ferri carb.*, as sold in the shops, is nothing like hydrate of iron."

Mr. BOVILL said in his cross-examination he had put this question to Dr. Taylor: "Was not the hydrated oxide of iron formerly called carbonate of iron?" and in reply he said—"Yes, it was called carbonate of iron as the hydrated oxide of iron was called carbonate of iron; it was formerly used in medicine. For many years it was known as such."

Baron BRAMWELL: I am sure that Dr. Taylor did not say that which we know to be absolutely untrue. He says, "Hydrated oxide was formerly called carbonate." He further says—"not by scientific chemists. I cannot say if there is any article called carbonate of iron, except that sold in chemists' shops. If any one asked for carbonate of iron, they got oxide of iron."

Mr. BOVILL said that was just his case, but he would not rest it simply on the evidence of any witness of that sort, but it rested upon this: Chemists prepared their drugs and the matters which they dispensed from the *London Pharmacopœia*, and if any one now went to write down the present name of that carbonate of iron, they would call it sesqui-oxide of iron, though in 1836 they called it *ferri carb.*, and the *Pharmacopœia* stated how it was to be made, which every one of the scientific witnesses were obliged to admit would produce an oxide of iron. Well, if by adopting the process of the *London Pharmacopœia*, which all experienced chemists professed to follow, you actually produced oxide of iron, it showed at once that Dr. Taylor's evidence was accurate and perfectly correct. But now what happened? The explanation was before the court that because this carbonate of iron, as prepared according to the *Pharmacopœia*, would be a nasty red colour, and therefore objectionable to persons who desired to purchase it for medicine, chemists were now, contrary to the directions of the *Pharmacopœia*, preparing it by bringing it to a red heat; and when they did that, it was no longer a hydrated oxide.

Baron BRAMWELL: Now, really, Mr. Bovill, sooner or later I shall have to address the jury, and therefore I may as well tell you at once that you are wrong in this matter. I do not think, for my own part, that it signifies a straw; but still you are wrong. What the witnesses have said is this:—Dr. Frankland said, "The process in the *Pharmacopœia* describes different products, one of which is a pure carbonate; but that process is so difficult that it invariably forms a hydrated oxide." The result clearly is, that though there are processes in the *Pharmacopœia* to point out the manufacture of a pure carbonate, and one of which, if followed, would produce it, the article really sold as such never has been either a pure carbonate or a pure oxide.

Mr. BOVILL said it was not very material to his purpose whether it was so or not, but he should produce the evidence of men of the highest position in their profession who would tell them that they had actually purchased what was called carbonate of iron from the first chemists in London, and would prove that it was in truth the hydrated oxide. If that were so, then the jury would have no difficulty in coming to the conclusion that Mr. Laming in his patent, when he spoke of the use of carbonate of iron, described the same article which in 1849 Mr. Hills claimed as hydrated oxide of iron. On the other side it was urged that it was not the ordinary article sold as carbonate of iron which was intended by Laming, but what they termed "a strict carbonate," viz., an article in which there was carbonic acid chemically combined; but their witnesses were obliged to admit, that if what they called a strict carbonate of iron were exposed to the air, it would of necessity part with the carbonic acid which it contained, and leave the material a hydrated oxide of iron—exactly the same thing. So that he felt justified in asserting, in the first place, that carbonate of iron, as here used, must be taken to mean the hydrated oxide, which, as Dr. Taylor told them, was formerly called "carbonate of iron."

Baron BRAMWELL: I am really very sorry to say again it is not so. He says, "It was so called in the *Pharmacopœia*, but not scientifically."

Mr. BOVILL said when he used the term "strict carbonate," he meant as chemists used it in the laboratory. This specification of Laming was a document published to the world, that all might know what to use; and if the term here used could be taken to imply hydrated oxide of iron, for which, as he said, it was another name, independently of the laboratory, then Mr. Laming had pointed out the same thing as Mr Hills. If, on the other hand, "strict carbonate" was meant by Laming as used in the laboratory, then they had Mr. Hills, in his specification, at page 14, showing that what he called hydrated or precipitated oxide of iron might be conveniently prepared for this purpose by decomposing, amongst other things, muriate of iron with soda. Dr. Miller said distinctly, that with those words before him, he should use the carbonate of soda; and he was obliged to admit that, if he did so, he would get a "strict carbonate" of iron. He (Mr. Bovill) held in his hand a patent taken out by Mr. Hills, in October, 18, which that gentleman, however, was not willing to admit any knowledge of. In that patent "soda" was referred to. He said: "I pass it through a solution of caustic potash or lime, or caustic soda." Now, seeing the word "soda" was in question in connexion with the present patent, he (Mr. Bovill) thought the words he had read threw considerable light on Mr. Hills' meaning. Dr. Miller had told them that the word "soda" alone being used, he should, because it was the cheapest, infer that carbonate of soda was intended; and if so, the product would be a strict carbonate of iron.

Baron BRAMWELL: Does it mean both?

Mr. BOVILL: It may mean both.

Baron BRAMWELL: Because when a man says carbonate of iron, he means carbonate of iron and hydrated oxide.

Mr. BOVILL: Putting it as a matter of law, it looks rather difficult to maintain that.

Baron BRAMWELL: Rather.

Mr. BOVILL said when they came to look at the article, they found that it could not be prepared in a dry state without its being converted into a hydrated oxide because, by the least exposure to the air, it parted with its carbonic acid.

The ATTORNEY-GENERAL: You read only part of the sentence. You should have read to the end, where you would find an express direction, that if this is mixed with soda or anything else, it must be afterwards exposed to the air.

Mr. BOVILL said he had not forgotten that there was direction for making it afterwards into hydrated oxide. Up to this point, however, it must be assumed that they had got a strict carbonate, and then came the direction to absorb it in sawdust or other porous material, and afterwards expose it to the air. It was evident from this and from the claim which Mr. Hills made, that he had endeavoured to spread his net as widely as possible, so as altogether to prevent the use of oxides of iron. But the matter did not rest here, for Mr. Laming not only spoke of the carbonate of iron, but described the mode of preparing it, and he said in effect—"I care not by what name you call it; the substance I mean is to be produced by decomposing muriate of iron by means of lime, for the purpose of purifying gas." That is a process which all the chemists agreed would produce the strict carbonate of the laboratory; and Laming added, "the oxides or carbonates which result are useful for the said purification, and need not be removed." Now he (Mr Bovill) would ask whether, after this publication of Laming in 1847, Mr. Hills had any right to come forward and say, "I now claim the use of these oxides or carbonates as prepared by muriate of iron and lime. I claim them for the purification of gas, and I claim them as hydrated oxide of iron." He knew of these two patents he had Croll's and Laming's specification before him, in each of which it was said that oxides of iron might be employed for the purification of gas, and therefore it was not possible for another man to maintain a patent for identically the same thing. He (Mr. Bovill) granted that if his renovation process was new, he might properly take out a patent for that, as an improvement upon the method then in use under Croll's patent of roasting off the sulphur; but let him confine his attention to that, and disclaim all the rest. The Attorney-General had told them that his client claimed only the hydrated oxide of iron (a substance dry and simple in itself), whereas Mr. Laming's claim was for the chloride of calcium, which was a deliquescent substance. But the fact was, Mr. Hills in his specification, in describing the mode of preparing his hydrated oxide of iron, said it might be usefully prepared by decomposing muriate of iron in magnesia; and it had come out in evidence that in that way they would get a substance in precisely the same delequiscent state, and producing exactly the same results as by the chloride of calcium and lime which Laming described.

Baron BRAMWELL: I think you need not labour at this, because Dr. Miller told us that if lime were used as suggested by the plaintiff, it is identical with Laming's. What I mean is this—as I understand your proposition it is that, inasmuch as Hills claims the use of hydrated oxides, of which he shows a mode of preparation in a way identical to that which Laming shows, therefore they are both the same things. Your facts upon that I should say you need not labour, because we have the evidence of Dr. Miller.

Mr. BOVILL, after quoting and commenting on the passages in Hills' and Laming's specification which bore on this point, and showing the similarity of results in each, proceeded to say that the case did not rest there. Mr. Laming in his patent said: "To obtain this carbonate in an economical manner, I throw down from ammoniacal or gas liquor obtained in making coal gas, and previously distilled or not, the sulphur which it contains, and having drawn off the clear liquid, I next precipitate its carbonic acid, or instead of making two separate precipitates, I throw down a mixed sulphuret and carbonate of the precipitant. I prefer to precipitate by means of the muriate or sulphate of lime." Now, what he claimed there was the use of gas liquor precipitated by means of the muriate of iron, and he called that an oxide or carbonate.

Baron BRAMWELL: Surely, Mr. Bovill, he does not call it oxide or carbonate?

Mr. BOVILL: He has previously spoken of oxides or carbonates.

Baron BRAMWELL (to Mr. Campbell): Do you remember the passage in which Laming says, "Under certain circumstances it may be desirable to make it (that is, chloride of calcium), for the purposes of gas purification, by decomposing muriate of iron by means of lime, or chalk when the latter will suffice. In such cases the oxides or carbonates which result are useful for the said purification, and need not be removed." Would an oxide result?

Mr. *Campbell:* If he decomposed the chlorides by chalk; in which case he would have to employ a high temperature. That would be the only way in which he could do it, and he would get an anhydrous peroxide of iron and chloride of calcium.

Baron BRAMWELL: But if he used lime he would get a carbonate?

Mr. *Campbell:* No; he would get hydrated protoxide of iron.

Baron BRAMWELL: But would he get a carbonate?

Mr. *Campbell:* Not at all; the thing is false.

Baron BRAMWELL: That proves your case better, Mr. Bovill.

Mr. BOVILL said Dr. Campbell's evidence proved that in no sense was carbonate correct; but Mr. Hills said the oxides or carbonates. He now passed on to the next matter which Mr. Laming had suggested, and it would be seen, as they went on step by step, that Mr. Hills had followed him, and mentioned the same things which he said would produce hydrated or precipitated oxides, and which Mr. Laming called oxides or carbonates. Mr. Laming told them that to obtain this in an economical manner he employed the ammoniacal or gas liquor obtained in making coal gas, and he (Mr. Bovill) had obtained the admission from the chemists who had been examined that the gas liquor in great part consisted of hydro-sulphuret of ammonia. Then, if they turned to page 14 of Mr. Hills' patent, they would find that he also stated—"Hydrated or precipitated oxides of iron may be conveniently prepared for these purposes by decomposing sulphate or muriate of iron with hydro-sulphuret of ammonia, or with lime, magnesia, potash, or soda; they may then be absorbed into or mixed with sawdust, peat, charcoal, or breeze, or other such material, and afterwards exposed to the air." In addition to this statement in the specification, it had been elicited from the plaintiff in evidence that he had produced this substance from gas liquor, and that in a letter to the Chartered Company, in April, 1850, he proposed to purify their gas without lime, and stated that he should require their gas liquor to make his purifying material with. He (Mr. Bovill) had been informed that, practically, the hydro-sulphuret of ammonia could not be used on account of its great expense, except in the form of gas liquor. So that, step by step as they went on, they found that everything which Hills' described as the means of producing this substance was identical with that of Laming's.

Baron BRAMWELL: It is clear, whatever may be the value of it, that Laming in his specification describes the use of certain materials for the purpose of preparing chloride of calcium and a metallic oxide; and Hills in his describes the use of the same materials for the purpose of producing hydrated oxide of iron. I think the Attorney-General would accede that.

The ATTORNEY-GENERAL: I accede it as to two or three materials.

Baron BRAMWELL: You have shown that it is identical as to lime and

sawdust. I do not say that that, as a bare proposition of law, may entitle you to a verdict, but as far as addressing the jury in order to make that out, I should think, as my brother Erle would say, that may be taken as datum.

Mr. BOVILL: I shall ask for your lordship's direction to the jury upon the subject.

Baron BRAMWELL: But I thought you were trying to prove identity? That is proved—it is acceded.

Mr. BOVILL: Then I hardly see, if your lordship is satisfied upon that, what point there is for the jury.

Baron BRAMWELL (to Mr. Campbell): Supposing you were preparing chloride of calcium as the thing you wanted to get, and not wanting to get protoxide or peroxide of iron, hydrated or anhydrous, you would use a certain proportion of two carbonates?

Mr. *Campbell:* Yes.

Baron BRAMWELL: Supposing your object was to get the hydrated protoxide, as mentioned in the first instance, afterwards to become peroxide, would you use the same materials and in the same proportion?

Mr. *Campbell:* Yes.

Baron BRAMWELL: That would be a necessary chemical fact?

Mr. *Campbell:* Yes.

Baron BRAMWELL: And you could not interpose anything else?

Mr. *Campbell:* Yes, you could add a large excess of lime or chalk, but you would not get a real chemical decomposition.

Baron BRAMWELL: You would get no benefit from it?

Mr. *Campbell:* No.

Mr. BOVILL: Perhaps your lordship will take a note of that.

Baron BRAMWELL: I will, for I think it is important. His lordship read his note as follows:—"To prepare chloride of calcium as a principal object, or to prepare oxide of iron as a principal object, as described in the specifications of Laming and Hills respectively, the same proportions of materials should be used." If I were the Attorney-General—he said—it seems to me that the possible point I should make against you is this: Laming says I use chloride of calcium and carbonate of iron, and I will tell you how I get them. The plaintiff says, I use hydrated oxide, and I will tell you how I get that. The patents are not, in either case, for the modes in which the materials are obtained, and both statements might have been left out of the specifications; and if they had been, all your arguments would fall to the ground. That is what he would say. Do not suppose that I am expressing any final opinion against you. It seems to me that the Attorney-General will say, "Leave out the way in which the materials are to be prepared, for that has nothing to do with the patents themselves." Let me remind you that there is this difference in the two processes:—According to Laming's specification, the two things result mechanically combined; and according to the evidence, the conversion of the protoxide into peroxide is slow, on account of the mechanical admixture of chloride of calcium, which covers up the particles of the protoxide, and prevents its separating as soon as possible. Whereas Hills says, I do separate it, and I take away the oxide and expose it to the air.

Mr. BOVILL: No, my lord.

Baron BRAMWELL: He does not say so in words, but in effect.

Mr. BOVILL referred to Hills' specification, page 7, line 15, in which he claims the hydrated oxide of iron, either alone or mixed with sulphate of lime, &c., or in conjunction with any other purifying material.

Baron BRAMWELL: But that is not the chloride of calcium.

Mr. BOVILL submitted that there would be the same kind of deliquescent or slimy matter by the use of magnesia, which would equally retard oxidization.

The ATTORNEY-GENERAL said Laming used it in the process, and Hills after the material was employed.

Mr. BOVILL contended that the same substance was employed in both cases, only Mr. Hills was ingenious enough to call things by other names. So far as the hydrated oxide of iron was concerned, it was known as absorbing sulphuretted hydrogen long before 1840; it had been pointed out by Croll and referred to by Laming, and they had here identically the same two things for producing the same substance, which used in precisely the same manner would produce precisely similar results. They could not reject or consider as unpublished any part of Laming's specification—for whatever he claimed, or whether his patent was bad or good, was perfectly immaterial. If he had only written a paper and published it in the philosophical transactions containing these facts it would have been sufficient to destroy plaintiff's right to a patent for the same things; and it mattered not whether he had called things by right names or wrong ones, if he had told the world that gas might be purified by these very substances. The learned counsel proceeded to point out the fact that Mr. Hills claimed the use of these materials in a damp state, and showed that both Laming and Croll before him had prescribed their use in the same way. Mr. Hills moreover stated that the material could be better employed in combination with some porous material, as sawdust, breeze, &c.; and they would find that Laming also stated—"For this purpose I damp it and dispose it, mixed or unmixed with sawdust or other matter." So that every single thing, sawdust, gas liquor, &c., which Hills described, had been already pointed out in a most minute manner by those who had preceded him; and there was not a single thing in which, by simple analysis, it would not be found, though names were changed, the substances were not the same—all tending to show identity of substance and object, and therefore that the invention of the plaintiff was not entitled to be considered as new. Let it not be supposed he was asserting that Croll's process of roasting or that of Laming answered commercially, so as to produce the result which now had taken place by means of renovation. No doubt, by the discovery of that invention, oxides of iron had been brought into extensive and valuable operation; and if Mr. Hills had confined himself to that which he said was his discovery, so far as this part of the case was concerned, no objection would have arisen; and even at this day, if by the verdict of the jury they should say that the first part of his specification was not proved, he could disclaim that and preserve his patent. With this question of renovation, however, he had now to deal. The second part of the plaintiff's claim was for "repeatedly renovating or re-oxidizing the said purifying materials by the action of the air, whenever they from time to time cease to absorb sulphuretted hydrogen, so that they may be used over and over again to purify the gas." Now, he (Mr. Bovill) began at the outset of dealing with this claim, by asserting that it was a fact, well known to chemical men long before the date of Mr. Hills' patent, that the sulphur with which oxide of iron was charged would be given off by the exposure of the substance to the air. Mr. Hills claimed, however, that he was the discoverer of that process of renovation as applied to gas; and the case for the defendants on this point was, that not only the principle generally, but the practice as applied in gas manufacture, was known to other persons before the date of the patent, and therefore Mr. Hills had no claim to be regarded as the inventor. In addition to this, he would be able to prove to the jury the means by which Mr. Hills obtained his knowledge; and that, instead of being his invention, it was the invention of Mr. Evans. Having referred to the evidence of the Rev. T. P. Dale and Mr. Barnard in support of the plaintiff's claim, the learned counsel referred to the patent obtained by Mr. Hills in 1848, the specification of which was not filed until April, 1849. That patent was for improvements in treating certain salts and gases or vapours, and for increasing the illuminating power of gas,—a title sufficiently comprehensive to have included the invention now claimed, if at that time the plaintiff had been in possession of it; and according to his own evidence he had perfected the invention at the latter part of 1848, But then they came to a more important document—the patent upon which they were now proceeding. He took out this patent in the month of November, 1849, having specified his previous one in April. According to his account, he had discovered the renovating process at the end of 1848, and the Attorney-General had introduced it to the notice of the jury as an invention of the most valuable character in regard to the life and health of Her Majesty's subjects. Any man who had made such an important discovery would surely have stated it in so many words, when he went before the Attorney-General to tell him what he was taking out a patent for. But the jury were to suppose that though this, one of the most valuable discoveries of modern times, had been made by him at the end of 1848, he never attempted to take out a patent for it, but left it for nine months without doing a single thing; and now he asked them to believe that the patent which he did take out at the end of that time was intended to cover it. That patent was for "An improved mode of compressing peat for making fuel or gas, and of manufacturing gas, and of obtaining certain substances applicable to purifying the same." Those substances, as he (Mr. Bovill) would show, had no relation to this subject at all. When he went to take out that patent, being opposed, it was necessary to tell the Attorney-General what he was applying for, and he handed in a paper containing an account of his invention. [The learned counsel read the deposit-paper, and commented upon it at length.] The only portion which it was alleged applied to the present claim was that in which he told the Attorney-General that his invention was "for absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again by heat, &c., or taking off the atmospheric pressure." Now here was not one word about the use of hydrated oxide of iron for the purification of gas, nor of the exposure of the substance to the air for the purpose of renovation; nor could the method of removing gases from porous bodies, here referred to, be taken to include that.

Baron BRAMWELL said he thought he should tell the jury that this was not a well-founded topic, and that it would have been a very indiscreet thing for the plaintiff to have put this invention into his specification of 1848, especially as he stated he had not perfected it till November in that year. It was a legitimate topic to say that he could not have known it when he took out his patent in 1848; but he did not think it proved anything that the plaintiff had not put it in his specification of April, 1849.

Mr. BOVILL said if the gentlemen of the jury knew anything about patents, they would be aware that at one time persons accustomed to such matters always kept a patent with some general title open, into which they could put anything which they discovered during the six months within which they had to fill their specifications, and he believed this was the case with Mr. Hills; and though he agreed with his lordship, as a general observation applicable to matters of this sort, that it would not have been a safe thing for a man to put in his specification a discovery which he had not perfected, yet he was persuaded Mr. Hills would have done so had he known this in 1849, because the title of the patent was a rather better one than the present. The learned counsel then, at great length, narrated the facts disclosed in the evidence for the defence as to the experiments which were conducted at the Chartered Gas-Works by Laming and Hills, and the discovery by Mr. Evans of the revivification of the oxide of iron, &c., &c.

Baron BRAMWELL, referring to the 5th claim on the plaintiff's deposit-paper, inquired of Mr. Campbell whether a simple porous body, such as sawdust with water, would absorb sulphuretted hydrogen.

Mr. *Campbell:* It would mechanically.

Baron BRAMWELL: Would it be given off by exposure to the air?

Mr. *Campbell:* It would.

Baron BRAMWELL: Probably be assisted by the removal of the atmospheric pressure or by heat?

Mr. *Campbell:* It would.

The ATTORNEY-GENERAL: Perhaps your lordship will ask him whether it would be sufficient.

Baron BRAMWELL: Would it effectually do it?

Mr. *Campbell:* No, my lord; it would be valueless.

Mr. BOVILL proceeded with his address, and referred to the experiments made by the witnesses on the other side with the process described by Laming, and which they had asserted was a failure; and he then commented upon the evidence given as to the partnership arrangements between Laming, Hills, and Owen. The learned gentleman concluded his address, which in the whole occupied about six hours and a half, by saying,—Under these circumstances I ask for your verdict not only on the ground that Mr. Hills' claim to the use of hydrated oxide of iron is not new, but also on the other ground, that he is not the person who discovered the renovation of the material so employed. This, gentlemen, is the case that I have to present to you, and, together with the objections which I have submitted to my lord more in detail, in the result I ask from you, and from my lord, a decision against the plaintiff on both points and on each ground.

Baron BRAMWELL: I may mention for the convenience of both side that I shall leave to the jury the questions whether the invention new as a whole and in each of its parts. If they think not, I shall ask which part they consider it has failed, or whether it has failed in the whol and I shall present to them those considerations which will be brought f ward for the purpose of showing that it is not new as a whole, and that is not new in its parts. There are some objections which Mr. Bovill as raised which are entirely for me—others ought to go to the jury; and w en I have their verdict, I shall say what ought to be done.

A. A. Croll, Esq., examined by Mr. WEBSTER.

I am a civil engineer, and have had great experience in the manufacture of gas, having been engaged in connexion with it for twenty yea In 1840 I was superintendent of the Brick Lane works of the Charter Company, and in that year I took out a patent for the process of purification which I used at those works. I obtained oxide of iron by precipi ing it from sulphate of iron by means of ammoniacal liquor, and also by ans of caustic lime and slacked lime, and I used that for the purificatio of gas. At that time my attention was not directed to the question of hy ted or anhydrous oxides—that question arose afterwards. I had no in what state the oxide was in, but I obtained certain results which ind me to specify "oxides" generally. In my specification, page 2, line 20 say:—"After the gas has been submitted to this process (for removi the am-

monia) it should have a further purification to free it from the remaining portion of the sulphuretted hydrogen, which purification is to be effected by means of the oxides hereinafter described." The getting rid of the sulphuretted hydrogen was the great object in view, and I specify for the purpose the use of a chloride of manganese, which has the effect of removing ammonia and a considerable portion of the sulphuretted hydrogen. It did succeed, and I used it to the extent of about 20,000 feet per day—not every day—between the time of taking out the patent and specifying it, for the purpose of gaining a sufficient amount of information for the purpose. I did not do it practically upon a large scale for the whole works, but in an experimental apparatus which I had put up for trying it. The gas so purified was used by the public with the other gas. These experiments extended over some months, and were made not only with the oxides of iron, but I used the black oxide of manganese perhaps to even a larger extent. According to my knowledge and experience at the time, my specification contains a correct description of what I did, and the result satisfied me that the sulphuretted hydrogen was removed. The material was used in a dry-lime purifier, mixed with fine breeze; and after undergoing the process of purification, I renovated it by placing it on the top of the retort-beds at the Brick Lane station. There are a large number of retorts set in arches, and upon the top of those arches I placed the material with which I had purified the gas, for the purpose of expelling the sulphur, and I then used it over and over again. The temperature of the retort-beds would be something like 400° or 600°, and I believe the result was to expel the sulphur; but whether it was so or not, I am certain that I used the material with effect over and over again. There was no other impurity removed besides the sulphur, so as to render it capable of being used again; and so far as the experiment was concerned, I was satisfied that that was expelled. Where the purifiers were I had not an opportunity of employing them and allowing the material to remain, and it was taken immediately from the purifiers and placed upon the top of the beds in the ordinary course of business. It was done quite openly. I believe there has been a considerable difference of opinion as to which is the cheapest process, the lime or the oxide. I have had the opportunity of using any of the processes of Hills or Laming, but I have not done so until very lately, and I would not do so now if I could use the lime and were allowed the opportunity of running off the refuse. Assuming that you have an outlet for the refuse, the lime process is the cheapest. I only commenced to use the oxide of iron a month ago. I sold my patent to Owen and Mertens, and when I did so, I said that I conceived I had a perfect right to use oxides of iron to purify gas; but as I did not wish to subject myself to a law-suit, I must have the consent of all persons to use it anywhere, and I had a licence granted for that purpose by Hills, Laming, and others. When they came to me, they said: "We have been infringing your patent all along—will you sell it? That was Mr. Owen, Mr. Mertens, and, I think, Mr. Laming. I consented to do so, and made it part of the terms of sale that I should have a licence to use all the patents, including Hills'.

The ATTORNEY-GENERAL objected to this evidence, which related to a transaction between witness and others, and not between him and Hills.

Baron BRAMWELL: I do not at present understand the relevancy of it.

Mr. BOVILL: The relevancy of it is this: I opened that the three patents became the common property of a joint concern, and that they (Owen and Mertens) licensed other people. This is to show that by another deed Croll sold his patent to the joint concern, but claimed the right to use their patent because he was the original patentee of oxides of iron.

Baron BRAMWELL: If you can show any transaction between him and Hills, that would be relevant.

The ATTORNEY-GENERAL: I am instructed to deny that any arrangement took place between him and Hills, or any one else, by which Hills gave license to use hydrated oxide of iron, except upon some consideration. Hills was not a party to this arrangement.

Examination resumed: Hills was not a party to this arrangement; but that was the condition which I made, and I obtained it.

Baron BRAMWELL: I have not taken that down clearly. I cannot take down the terms of a bargain between him and Laming and Owen.

Mr. WEBSTER: Cannot you take it that it was a condition of sale that he should have a licence under Hills' patent for nothing?

Baron BRAMWELL: No.

Examination continued: I have received royalties to such an extent that I could not get an extension of my patent.

By Baron BRAMWELL: My patent has been extensively worked—not that part of it. I granted licences to several companies, and they might have used oxides of iron. I did not consider it at all necessary to work that part, and would not do it now but from the circumstance that I am prevented from putting my refuse lime-water into the Thames.

By Mr. WEBSTER: The witness Upward did not come to me until after the date of my specification.

Cross-examined by the ATTORNEY-GENERAL: I made experiments with various oxides before I took out my patent. I did not know whether they were hydrated or anhydrous, and did not make myself master of any distinction up to the date of my specification, but I found I obtained an active purification at one time greater than at another; and for that reason I believed that the metal was in some state of oxide, and therefore I specified "oxides." I never made the material myself and sold it to others; I did not consider it of value. I granted licences to others, and they may have used it; but I do not know in what state they used it. I do not remember at all whether it was not until 1849 that I acquired a knowledge of the distinction between hydrated and anhydrous oxides; it was long before the proceedings in this matter took place, but I have no distinct recollection. I do not remember that I ever knew of Mr. Hills' patent until I heard of these prosecutions of the companies for using it. I am the lessee of the Surrey Gas-Works and of the Winchester Gas-Works, and I am a director of the Tottenham Gas Company.

The ATTORNEY-GENERAL: Did you, four years after the date of your patent, read a paper upon the purification of coal gas at the Institution of Civil Engineers, in which this passage occurs:—"These obstacles will work the almost universal abandonment of wet-lime purifiers. Now, however, in connexion with this purifying of gas from ammonia, the dry-lime purifier will become, it is anticipated, the only system used for the abstraction of sulphuretted hydrogen?"—and was that your impression at the time?

Witness: Yes. In all the companies with which I was connected down to 1850, the mode of purifying from sulphuretted hydrogen was by means of dry-lime.

The ATTORNEY-GENERAL: I suppose, but for the effect upon the atmosphere, and, consequently, upon the health and comfort of those connected with the works, you would do so still?

Witness: Not for that. I think the health of the persons operating is less affected when wet lime is used than oxide of iron. The wet lime produces the "blue billy;" but if you have the opportunity of running that away, it does not matter. We have done so until within the last twelve months, and I believe if we had continued to do so, the Thames would not have been so bad as it is.

Re-examined by Mr. BOVILL: The paper which I read at the Institution of Civil Engineers had no reference to the practicability of using oxide of iron, but was intended to show what, commercially, was the most advantageous thing to use. The roasting of the material over the retorts was done in the open air; I never anticipated doing it in any other way. The ovens in which I propose to stir it were open ovens. I have done it at a red heat, but that was not the common method. My chemical knowledge is sufficient to enable me to state that what I produced was both hydrated and anhydrous, and that both will purify gas most effectually. The great object is to get the atoms as divisible as possible, and that, I believe, is the secret of the matter.

Baron BRAMWELL: I infer that you have been asked the question about the paper read at the Institution of Civil Engineers, for the purpose of proving that your own process under the patent had failed. It might have failed commercially, but had it failed because it was an impractical and inoperative mode of doing it?

Witness: Certainly not, if you will allow me to state the reason. The other part of my patent was the most valuable part—the removal of the ammonia, which Mr. Hills knows, he having entered into an arrangement with me for its use.

By Baron BRAMWELL: My plan was to roast the oxide in an open oven, and to stir it about with a rod. When I stated in my specification "thoroughly red," my idea was that it would be necessary to get it to a red heat (not knowing that the oxides of iron were hydrated and anhydrous) in order to expel the sulphur. It did not get to a red heat on the top of the retorts. I was not at all astonished at the result. I obtained a material which was very active for purifying a large quantity of gas. I thought that it would be better, practically, to have ovens, believing that if I could obtain a red heat it would have the best effect. Oxide of iron obtained by precipitating sulphate of iron in ammoniacal liquor would be hydrated.

Mr. *Campbell*, in answer to the learned judge, said it would be so.

Mr. *Croll*, in further examination, said with slacked lime it would also be hydrated. I cannot say what became of the sulphur absorbed by the oxide. It is mechanically connected with it, and by this process it gradually becomes volatilized.

Baron BRAMWELL: I thought it would be in a solid shape.

Witness: You cannot see it among the material, the red colour predominates so much. I did not know what became of the oxygen or the sulphur at that time.

Alfred King, Esq., examined by Mr. DENMAN.

I am the engineer of the Liverpool Gaslight Company and also of the Liverpool United Gas Company, and have been so since the year 1826. In the course of that time I have given considerable attention to the mode of purifying gas. Until April, 1856, I used the lime process. At one of my stations I then commenced the use of oxide of iron, prepared by decomposing the sulphate of iron with lime, producing an oxide of iron and a sulphate of lime. That oxide, by exposure to air, became a hydrated peroxide. When it becomes saturated with sulphuretted hydrogen, it is removed from the purifying vessels and exposed to the air; it thus recovers its power, and is used over and over again. I have used the same material certainly as often as thirty-five times. I have occasionally burnt off the sulphur in an oven heated to redness. I believe that that heat renders the oxide anhydrous; but I do not profess to be a chemist. In that condition I have used it over and over again—in one case as many as twenty-two times, and have found it effectual in purifying gas.

Baron BRAMWELL: I thought it was a conceded matter between the parties that if heated to a red heat it would not purify?

Mr. BOVILL: No; not that it would not purify, but that, being heated to a red heat, it would be anhydrous.

Cross-examined by the ATTORNEY-GENERAL: The preparation of the oxide, by decomposing sulphate of iron with lime, was done under my direction. Several tons were so done. The process was to take the common green copperas and place it in a mill, adding a little water to make a pasty mass; then to put in a quantity of lime and as much more water as was necessary to make it a stiff paste. The mass was then removed and cut to pieces with a spade, and as it dried it became a powder. The sulphate of lime remained part of the mixture, and the combined substance was placed in the purifier, and gas passed through it. I do not profess to give a chemical opinion, but I believe the oxide first produced was hydrated. When removed from the purifying vessel, it was thrown upon a floor and exposed to the action of the atmosphere, which completely renovated it. The application of heat was a subsequent process. The substance became at length so diluted with sulphur that it was, after some twenty purifications, put into an oven furnished with flues, and heated till it became red-hot. It was frequently stirred, so as to expose it more thoroughly to the action of the atmospheric air and heat, and the effect was to burn off the sulphur. The material was then taken from the oven and laid out to cool, and afterwards used again, as when first prepared. This I began to do in 1856, and I have continued to use it till the present time.

By Mr. BOVILL: It answered very well afterwards. I am not prepared to say as well as at first, but it did purify, and after three or four times just as well.

By the JURY: I was not guided by any instructions.

Richard Laming, Esq., examined by Mr. WEBSTER.

I am a member of the College of Surgeons, and the patentee of one of the specifications before the court. In that specification I speak of the use of a metallic carbonate which may be made from the sulphate of iron and lime. I have heard the evidence of the last witnesses as to the way in which Mr. Croll made his oxide, and Mr. King mixed his. The only difference that I know of is this: that in the one case, when a carbonate of any kind is used, whether chalk or carbonate of soda, and whether with gas liquor, which contains carbonate of ammonia, or in fact any other alkaline carbonate or earth capable of precipitating the metal, whenever an oxide is precipitated, some of it goes down with the oxide and tends to keep the particles more apart than they would otherwise be, and thus more fit for any kind of chemical action; but the final result is the same, inasmuch as it contains in both cases hydrated peroxide of iron. I agree with Dr. Taylor in the opinion which he expresses that with regard to the fitness of these oxides it is nothing more nor less than a question of molecular separation. The process described by Mr. Croll is the same as described in my specification, page 5, line 27. When lime is used the process is precisely the same.

Baron BRAMWELL: I think I understand him that by the process on page 5 he describes the preparation of a metallic carbonate, and therefore the result in both cases is the same.

The ATTORNEY-GENERAL: Laming speaks of the muriate of lime.

Mr. WEBSTER: And sulphate also.

Baron BRAMWELL: Yes, looking at line 35 I should say so.

Mr. HINDMARCH: That is decomposed by ammonia.

Baron BRAMWELL: The fact is, he is like Molière's *Bourgeois Gentilhomme*—he has been talking prose all his life without knowing it.

Witness: If the proto-salt of iron is used, and it is precipitated with lime, it is then a protoxide of iron—a hydrated protoxide which changes by the slightest exposure to the air in the process which I describe of mixing it with sawdust to make it available for the purpose of purifying gas into a hydrated peroxide.

Mr. HINDMARCH: The clause to which your lordship called attention is that in which the salt of iron is decomposed by ammonia and not by lime.

Mr. WEBSTER: Looking at Hills' specification (page 14, line 7), where he says, "Hydrated or precipitated oxides of iron may be conveniently prepared for these purposes by decomposing sulphate or muriate of iron with hydrosulphuret of ammonia, or with lime, magnesia, potash, or soda; they may then be absorbed," &c. Let me ask you whether, so far as that relates to precipitated oxides prepared from sulphate of iron by lime, it differs in any way from one of the substances which you have called metallic carbonate?

Witness: Certainly not, except that in my cases there are a few particles of carbonic acid superadded to the hydrated peroxide of iron, which in no respect whatever interferes with the efficacy of the substance for the purification of gas.

Mr. WEBSTER: In line 16, page 5, of your specification you speak of decomposing muriate of iron with lime. Do you find the same thing in Hills' specification in page 14, lines 9 and 10?

Witness: Yes.

Baron BRAMWELL: That was proved by Dr. Miller.

Mr. WEBSTER: You speak of "chalk, when the latter will suffice." I think one of the witnesses said chalk was only capable of being used when heat was applied.

Witness: Then he is decidedly wrong. I have decomposed proto-sulphate and proto-muriate of iron by means of chalk at the ordinary temperature of the atmosphere, and produced a hydrated oxide of iron. Dr. Richardson saw the change take place. I will just explain where scientific men have made a mistake. They are very apt to do these things in a bottle, excluding the atmosphere. Practical men are in the habit of operating in the open air, and scientific men do not take into account the influence of the atmosphere. It is very true that the proto-salt of iron will not be decomposed by chalk in a bottle, but it is equally true that it will be if placed on the floor. I have in my hand some proto-sulphate of iron mixed with chalk, and then opened for the purpose of gas purifying by mixing it with sawdust. In the course of three hours at the outside it changed to this red colour, having been white when I mixed it. [Specimen exhibited.] So that a red heat is not necessary, nor was it ever contemplated by me. I call these carbonates of iron, but they are to all intents and purposes hydrated peroxides of iron. I find that chemical nomenclature changes from day to day, so that the only safe practice for a person who wishes to be understood is to use language which the public are accustomed to. As new lights arose——

Baron BRAMWELL: New darkness I should call it. In my opinion it was a very improper name.

Mr. BOVILL: In the *Pharmacopœia* there is no mention of hydrated oxide of iron.

Baron BRAMWELL: Very possibly not; but surely common sense should dictate the use of a correct term? I am inclined to think, in point of law, that the true name must be given.

Mr. BOVILL: Your lordship will recollect that, except with highly scientific persons, hydrated oxide of iron was known as carbonate of iron.

Baron BRAMWELL: That I deny.

Mr. WEBSTER: In the case of *Savory v. Price* it was contended that the patentee ought to use a name known in shops, and the patent was opposed on that ground.

Witness: I am a medical man, and have been so for many years. When I have wished to prescribe sesqui-oxide, I have never thought of using any other term than carbonate of iron, and I believe the public could not misunderstand it.

Examination resumed: In that part of my specification in which I say, "Another part of my invention consists in the use of the carbonates of manganese, iron, zinc, and lead, for the purification of coal gas," those materials were to be used in a damp state with sawdust. The gas will not pass through them unless they are porous, and to be porous they must not be pasty. There is no difference between the manner of using metallic oxides and carbons described in my specification and in Hills'. I should say that any person wishing to describe my process in other language might very safely adopt his.

By Baron BRAMWELL: There is such a thing as carbonate of iron. It is called by precisely the same name. Chemists in the laboratory understand by carbonate of iron that which they can throw down beneath the surface of a liquid and keep from the influence of the atmosphere; but the public know nothing of it—they never saw it. It is a commercial curiosity; it is obliged to be kept, like a fish, in water; it dies if taken out, and becomes something else. It cannot be prepared on a large scale in a dry state.

Mr. WEBSTER: In your specification, page 6, line 24, I see you claim the black oxide of manganese for purifying from ammonia and hydro- , and there you speak of the carbonic acid being driven off by a heat gradually approaching to redness—at what temperature does carbonic acid begin to go off?

Witness: It begins to go off as soon as the substance begins to be heated. The reference to heat in this passage applies only incidentally to carbonic acid. The intention here is to convert the carbonate of manganese into an oxide of manganese by a process of my own.

Examination in chief resumed: In 1847 and 1848 I was engaged with Mr. Lewis Thompson, who is a chemist well known to me by reputation. Being in Paris at that time, I obtained his assistance in carrying out some experiments in the purification of gas. My experiments in Paris were suspended in 1848, in consequence of the revolution. In that year I had a caveat entered at the Attorney-General's office against the granting of patents for the manufacture of gas. At that time a deposit-paper was given in to this effect—"For this purpose I simply expose to the air the sulphuret of iron, which results from the purification of illuminating gas by the hydrated peroxide of iron. This exposure causes it to change back to hydrated oxide of iron." It is dated Sept. 15, 1848, and is headed "Recovery of some of the purifying re-agents for repeated use." Mr. Newton attended to that business for me, as my agent. I obtained a French patent in February, 1849. It contains a paragraph, of which this is a translation:—"In the fifth part of this invention, I extract from the gas all the hydro-sulphuric acid which it contains, by means of the hydrated peroxide of iron; and the sixth part consists in renewing the hydrated peroxide of iron after its conversion into sulphuret of iron by the action of the gas, for which purpose I expose it to atmospheric air." I sent some materials on the 17th of July, 1849, to the Westminster Gas-Works, having obtained permission to do so; and that material was put into the purifying vessels. It consisted of proto-muriate of iron decomposed by lime, mixed with sawdust, and oxidized by the exposure to the air. It was a hydrate and a precipitate; there are hydrates which are not precipitates. The first lot I sent ready made; the second was mixed on the works. Muriate of iron decomposed by lime gives rise to chloride of calcium and hydrated protoxide of iron. There was nothing else but sawdust with it. It was put into the small purifiers on the 8th of August, and the gas which was passed through it continued to be purified from ammonia and sulphuretted hydrogen for several days. About 20,000 feet per day were sent through it, which gas was mixed with the other gas, and sold to the public. Altogether, about 900,000 feet were so purified, and there was no occasion to change the material until the 17th of August. I was informed that it was then taken out; and when I called to see if it was saturated and unable to do more work, I found the ground all round the purifier was marked as though with red ochre. Mr. Evans then told me he had made a great discovery, which was, that my material had recovered its purifying energy, after being saturated with sulphuretted hydrogen, by simply being exposed to the air. I then told him I was very sorry he had discovered my secret, as I did not intend him to do so. Mr. Evans was very sceptical on the point; he thought it was his discovery, and not mine, and it resulted in my obtaining from France the specification of the patent which I had taken out in the previous February. After that we agreed together to apply for a patent, as, finding my secret was no longer mine, I thought the only way to recover possession would be to join Mr. Evans in it. I did not know that Mr. Hills was engaged in making experiments at the works at the time. I applied for a patent, and was opposed by him. The date of sending in the second lot of materials was the 22nd of October, 1849, and it was put into the purifiers between then and the 26th. Finding I could no longer maintain my secret from Mr. Evans, I prepared that material at the works. I did not see Mr. Hills there. I do not think a more correct or faithful model of the works than that produced could be made. My experiments went on during some months, and the oxide was thrown out upon the ground, and changed from black to red, marking the pavement in all directions. On one occasion, during the time I have been speaking of, the material was lying against the scrubber at which Mr. Hills was working. When I applied for a patent, Mr. Hills opposed me personally, and Sir John Romilly told me that I had let Mr. Hills discover my secret. Mr. Hills was before the Attorney-General, face to face with me, and his brother too. No witnesses were examined. That was in April, 1850.

Baron BRAMWELL ruled that the remark said to be made by Sir John Romilly could not be taken in evidence, and he expressed a doubt whether even the decision of the learned Attorney-General on that occasion could be admitted in a case between the plaintiff and the London Gas Company.

The deed of arrangements between the plaintiff and Laming and Owen was put in and read, and a long conversation between the learned counsel and the court ensued upon it.

Witness, cross-examined by the ATTORNEY-GENERAL: It was sometime, and within a fortnight, after August 17, 1849, that Mr. Evans communicated to me the nature of his discovery. I was present on the occasion of the last trial, and heard Mr. Evans say, "Mr. Laming was not present when I made the discovery of the change in the colour of the material I informed him afterwards of what I had discovered. No observations were made by Mr. Laming about it which would lead me to think that he knew of it." It is perfectly true that nothing was said to lead him to believe it, but it led him to doubt it. I said all that I have said and he would not believe it, so I had to send for my French specification to convince him. I said nothing that had the effect of impressing his mind, and in substance he said to me that he believed he made the discovery for the first time.

The ATTORNEY-GENERAL objected to the admission of the French specification, and some conversation ensued thereupon.

Cross-examination resumed: I opposed the patent of Hills in 1848, and I put in these sheets of objection. I did not oppose his patent in 1849. In 1850 I obtained a patent, which was opposed by Mr. Hills, and a portion of my claim was struck out by the law officer. At a later period in that year I filed my specification under that patent, and in 1852 Mr. Hills instituted proceedings in *scire facias* to set it aside. I then applied to Sir Frederick Thesiger to be allowed to disclaim a portion, and my application was rejected because I had put into my heads of invention some things which were not in my deposit-paper, and into my deposit-paper some things which were not in the heads of invention. I therefore remained perfectly quiet, allowing the law to take its course; and I was afterwards told that by the judgment of the law my patent was at an end. After that there was another proceeding, which terminated in the deed just referred to, under a clause in which I have authorized the use of oxides by several gas companies, of course giving notice to Mr. Hills that I had done so. I do not know whether the companies continue to use them to the present moment. I know nothing of what has taken place during the last two or three years, except by hearsay. I retired from the firm in September 1854. Down to that time several companies continued to use them. The subject of the amount to be paid to Hills was submitted to arbitration. It was settled at a much higher sum than a penny—it was a sum greater than the profit made. I believe it was something like 4½d. Mr. Hills at last brought an action against me, and succeeded in recovering £800—that is to say, Owen and Mertens consented to give it him. I am not aware that anything else was done in relation to this matter until one of the companies resisted the payment of the royalty. I have instituted no legal proceedings against Hills to set aside his patent—my proceedings have all been moral. The term "carbonate of iron" means hydrated oxide of iron, with the simple addition of carbonic acid in it, which may be retained for a day or a year As long as the peroxide of iron is made by precipitation with a carbonate, I call it carbonate of iron, by which I understand protoxide of iron with carbonic acid in equivalent proportions. After being mixed with sawdust and exposed to the air, it will turn into an oxide in three hours. [Bottle handed to witness.] This is not pure carbonate of iron, there is some saline matter which I have not the means of analyzing. If you mix with a carbonate some mucilaginous matter so as to prevent the air getting into it, you may preserve it as effectually as in a stoppered bottle. I have tried to purify gas from sulphuretted hydrogen by means of a material in which there is hydrated oxide of iron with carbonic acid, but practically it is impossible, because the air must be mixed with it. I purified nearly the whole of the gas in Paris for a year with my carbonate of iron. The proportion of carbonic acid with it depends upon whether it is used directly after being prepared. When I mix this pure chemical carbonate of iron, in which the materials are combined in equivalent proportions with sawdust, in order to prepare it for purifying gas, if I instantly go and put it into a purifier, and shut it up, I get this very substance which you have shown here—impure carbonate of iron with a great deal of carbonic acid in it; but if I prepare it beforehand,

as gas companies are in the habit of doing, then there is not more perhaps than 4 or 5 per cent. of carbonic acid in it. I should say that it varied from a fraction to about 30 per cent. of carbonic acid, and I have no doubt that I have done it upon an average up to 8 or 10 per cent.

By Baron BRAMWELL: A substance can be at once an oxide of iron and a carbonate; in fact, all the carbonates of the metals are oxides of the carbonates. Carbonic oxide is a compound of carbon and oxygen. There is an oxygen in the iron which is distinct from that in the carbonic acid.

By Mr. BOVILL: The contents of this bottle are some of the vilest gas liquor which could be got, mixed with a proto-salt of iron. It has no pretence to be called a carbonate of iron in a pure state. When gas liquor is used for the purpose of precipitation, as stated in my patent, carbonate of iron is thrown down either by itself or mixed with sulphuret of iron.

Mr. BOVILL: When Mr. Hills, according to his plan, uses hydro-sulphuret of ammonia, what is thrown down?

Baron BRAMWELL: We learnt that when we were young, three days ago. No one disputes that.

Re-examination continued: When Mr. Hills uses muriate of iron and lime, he throws down, in every sense of the word, the same thing. When I use muriate of iron and lime I do not throw down a carbonate. I find that by some of Hills' processes he does throw down a carbonate, which he calls a hydrated precipitated oxide. If he uses muriate of iron and carbonate of magnesia, he throws down, not an oxide, but a carbonate. If he uses potash as sold in the market he throws down a carbonate—a thing which he calls an oxide.

The ATTORNEY-GENERAL: Do not say so.

Baron BRAMWELL: The paragraph is fairly open to remark, because he says, "They may *then* be used," clearly inferring that they may be used without further exposure to the air.

Mr. BOVILL: As regards the claim, is there the slightest difference between your process and Hills'?

Witness: Not the slightest.

Mr. *Alfred Vincent Newton*, examined by Mr. DENMAN.

I am a patent agent. On the 15th of September, 1848, I went before the Attorney-General with Mr. Laming. I remember a paper being handed in which contained the passage, "Recovery of some of the purifying re-agents for repeated use. For this purpose I simply expose to the air the sulphuret of iron which results from the purification of illuminating gas by hydrated peroxide of iron. This exposure causes it to change back again partly into a peroxide of iron, and partly into a sulphate of iron." I read that paper before the Attorney-General, and wrote the memorandum upon it the same day. I do not remember whether I was present in 1850, when the claim of Laming and Evans was in part struck out.

Some conversation took place upon it being proposed to call witnesses to speak to the correctness of the model of the Chartered works, the learned judge again expressing an opinion that it was an utter waste of time.

Henry Bannister (deputy-superintendent), *William Robinson*, and *Samuel Roberts*, workmen at the Chartered Company's works, were examined on the point; and a man named *M'Guire* was put into the box, upon which

The ATTORNEY-GENERAL said, there might have been an arch in the wall which had escaped the notice of his witnesses, and no doubt the model was a proper one.

A JURYMAN: We are quite satisfied that the model is correct.

FRIDAY, AUG. 13.

Frederick J. Evans, Esq., examined by Mr. WEBSTER.

I am the superintendent of the Chartered Gas Company at Westminster, and have been engaged in their service for twenty-five years. I remember that in July, 1849, the plaintiff attended before the court of directors, and obtained permission to make experiments for purifying the gas from ammonia by means of sawdust and water, and to be allowed to use one of our scrubbers for the purpose. [Witness pointed out on the model the position of the scrubber used by the plaintiff.] His first experiment was made on the 17th of July, and continued up to the 25th. Mr. Laming also made an application on the 17th of July, and obtained permission to make experiments for taking out ammonia and sulphuretted hydrogen. I have an entry in my book that the operation commenced of emptying the purifiers for him on the 20th of that month. He was allowed to use three vessels (pointed out), and he sent materials prepared by himself to fill the purifiers with. I have also the following entry in my book on the 10th of August:—"Commenced making experiments with Laming's purifying materials, for taking out the ammonia and sulphuretted hydrogen by means of the peroxide of iron and muriate of lime, in the small experimental apparatus, on Wednesday evening (the 8th), at half-past six." Those experiments went on for some time, and the evidence which Mr. Laming gave yesterday on the subject is substantially correct. The experiments of Mr. Hills went on until the 1st of October. In reference to Mr. Laming, when the gas had been passing through his process for some time, and we had purified a large quantity, it was found that the material had become foul. The purifier was then thrown out of action, and the stuff taken out. It had then been in use three or four days, and perhaps 60,000 or 70,000 feet had gone through it, which went into the gasholder in the usual manner. The material taken out of the purifier was put round the gasholder, coloured blue on the model; and the next morning, on going round to the place, I saw that the material, which was black when taken out, had become red. I was much struck with its appearance, and I took a portion and tested it by blowing a little foul gas upon it. Finding it again active, I put the material in the purifier, and it purified the gas as well as at first; and so I went on with it a great many times. It was on the 12th or 13th of August that I first discovered this; it was done in Mr. Laming's absence and without his knowledge. On a subsequent occasion I told him what I had discovered; he seemed very much struck, but said nothing. Afterwards he told me that I had got his secret, and he showed me the extract from his French patent. I considered that the experiment was quite satisfactory, and Mr. Laming and I agreed to take out a patent, which we were prevented from doing by Mr. Hills taking out his. I reported to the board the result of those experiments.

The ASSOCIATE read the report, as follows:—

Gas-Works, Horseferry Road, Jan. 26, 1850.

Gentlemen,—I beg most respectfully to make the following report on Mr. Laming's mode of purifying coal gas, as practised here as an experiment for some time past.

The material used consists of muriate of iron decomposed by lime, which forms muriate of lime and oxide of iron. This is mixed with water, and absorbed into sawdust, and put into the ordinary dry-lime purifier. The sulphur in the gas immediately combines with the oxide of iron, forming sulphuret of iron; the ammonia is at the same time taken out by means of the muriate of lime; the carbonate of ammonia in the gas effecting a double decomposition, part of the carbonic acid combining with the lime, and the muriatic acid with the ammonia.

The experiment was tried on the small scale, with the experimental purifiers, and was commenced on the 8th of August, 1849. It was found to remove the sulphur and ammonia most completely from the gas; but when the material was saturated, which it soon was, it was taken out, and fresh put in. If this had continued to have been the way of proceeding, it would have been quite a failure, on account of the expense; but it was observed accidentally, that the material had the property of recovering its former purifying power by exposure to the atmosphere; and, on putting it into the purifier a second time, it purified the gas as well as the first time; and, on taking it out a second time, it was equally effective again. I then suggested to Mr. Laming that, instead of taking the material out of the purifier, it would be far more economical to draw air through the material while in the purifier. This was done, and the same material was used six times over again. The first time of drawing air through the material while in the purifier took place on Oct. 22, 1849.

Finding the experiment so successful on a small scale, I determined to try it on a larger one in the four purifiers erected for the Houses of Parliament. In this experiment I wished to ascertain whether the gas could be kept quite clean during the time one purifier was being ventilated. The purifiers were all charged, and three of them put into action on the 20th of December, 1849; but the result was so different to the former experiment, although the material was mixed in a similar manner, that I could not account for the difference. I therefore wrote to Mr. Laming, who came, but could not discover the reason; he said he thought it arose from all the ammonia having been previously taken out of the gas by Johnson's material; to this I reminded him that on the former experiment he said the material would act better if the ammonia was previously taken out. He then went away, and in a short time after he brought a gentleman named Thompson, who was formerly associated with him in Paris, and who has again joined him. This gentleman had made the greater part of the experiments for Mr. Laming; and when the thing was explained to him, he said he would make some experiments upon it, and let me know.

The next day they both came, and Mr. Thompson said he had discovered the cause of the material not performing its proper action, and that it was owing to the change in the weather, which had set in very cold; and he says that the material does not act so well in cold weather as in warm. Mr. Laming then suggested that during the cold weather the air should be warmed previous to its coming into contact with the material, and also the gas likewise. Here the matter rests. The material is still in the purifiers, and does its work very partially; in fact, it is now quite useless as a purifying material for the whole of the gas we make. What it may do, if the suggestions of Mr. Laming are carried into effect, I cannot say (although I think Mr. Thompson is right in his conjecture).

In order, however, to give the court some data to form an opinion of the advantage or otherwise of this process over our mode of purifying by means of lime, I will assume that the experiment had been perfectly successful, and compare the cost of the two, by which it will be seen, if Mr. Laming's plan was adopted on this occasion, it would occasion an additional outlay of £489. 10s., or ·294d. per 1,000,000 feet over our present mode, which is simple, cheap, and effective.

I feel bound to admit that the plan, if successful, and putting cost out of the question, is a very simple and beautiful one, and has advantages over lime which would render its adoption desirable, as there is no smell during the process. But I must, at the same time, in justice to the company who allowed Mr. Laming to make his experiments on their works, and to myself, state, that when Mr. Laming mentioned his several plans for purification of gas to me, this one he said was too expensive, and would not do; and it was not until I requested some of the material to be sent, in order that I might try it, that the facts regarding the revivification of the material were accidentally discovered; and to the discovery of those facts, and to the suggestions given to Mr. Laming by myself respecting bringing the air in contact with the material while in the purifier, that the success of the first experiment is due, and which has completely altered the feature of the invention, as originally proposed by Mr. Laming.

I also discovered that the whole of the carbonic acid is not taken out by this mode of purification; therefore the gas would have to be brought into contact with lime to render it quite pure (Mr. Laming, in his letter, states that no lime would be required), which, of course, would add to the expense of purification; but I have not added this expense to the estimate, as, I presume, Mr. Laming includes the abstraction of the carbonic acid from the gas as part of his offer of purification.

There is, however, an extra expense to which we should be subjected if the plan was carried out, and that is, of providing some material to be used as luting for the retort-lids. At present we use the refuse lime; but, as the material used by Mr. Laming is totally unfit for that purpose, either fresh lime or loam would have to be provided; this I estimate would cost, at least, £150 per annum.

Trusting, gentlemen, I have laid the whole of the facts relating to this experiment before you, I have the honour to remain, your obedient servant,

F. J. EVANS.

WESTMINSTER STATION.

STATEMENT OF THE TOTAL COST FOR PURIFICATION FOR ONE YEAR, ENDING DECEMBER, 1849.

Lime used—1484 yards, at 10s. 6d.	£779	2	0
Labour to ditto	357	10	0
Cartage of refuse lime	91	8	0
Expenses of ventilation	100	0	0
Total cost	£1328	0	0
Ammoniacal liquor sold for the year	357	10	0
	£970	10	0
If the ammoniacal liquor sold for the year had been in proportion to the quarter to Christmas, it would have realized £700, or £342. 10s. more than above stated	342	10	0
Total cost of purification, deducting value of liquor	£628	0	0

The gas made for the year was 400,000,000, which will give ·376d. per 1,000,000 feet for purification.

COST BY MR. LAMING'S METHOD.

Mr. Laming requires 4½d. for every ton of coals carbonized on the works; he finding, delivering, and taking away the material when saturated; and, in addition, he is to have all the gas liquor and ammonia contained in the gas. The company, however, to be at the expense of labour in charging and discharging the purifiers. This I estimate at half the expense of lime. Then—

Coals carbonized—42,059 tons, at 4½d.	£789	0	0
Labour in charging and discharging	178	10	0
Cost of luting for retort-lids	150	0	0
Total cost of purification	£1117	10	0

Gas made—400,000,000, or ·670d. per 1,000,000 feet, being £489. 10s. per annum more than at present—

Mr. Laming's plan	£1117	10	0	at ·670d.	per 1,000,000 feet.
Present plan	628	0	0	at ·376d.	do. do.
Difference in favour of the present plan	£489	10	0	at ·294d.	per 1,000,000 feet.

Examination continued: In the first experiment, I think about 500,000 feet of gas passed through the material, and a very large quantity in the second, as the purifiers were ten feet square. All the gas so treated was supplied to the public. These experiments were done openly, so that all could see them; they were the subject of conversation among the men at the works, and I took the directors down and showed them the process. I mentioned my discovery to every one I saw, and amongst them to Mr. Lewis Thompson and to Mr. Hills, and his brother, Mr. Thos. Hills, who was working there at the same time. His plan required no one to work it; but so far as any men were employed in connexion with him, they were the same who put the sawdust in the scrubber as the oxide in the purifier. The experiments were going on in the thoroughfare of the yard; and at that time we were selling 300 or 400 chaldrons of coke a week, and the men who came to buy it saw where the experiments were conducted. The black and the red stuff were both lying about; in fact, the place was covered with it. The arch so much talked of was the passage-way through which the men brought the material, and the contrast of the colours would be sure to attract the attention of everybody. I am quite certain that Mr. Hawes, our deputy-governor,

saw it; I do not know whether he took any steps in reference to it. Mr. Thompson, who was sent for, saw it, and took samples. The process has never been discontinued since.

By Baron BRAMWELL: The failure of the experiment referred to in my report was entirely due to the cold weather. At first it purified on the large scale as well as on the small; but after a while it only did so partially, and I found that I should have to change the material so often that it would be too expensive. I wrote to Mr. Laming about it, and he came and brought Mr. Thompson, with whom we had a long conversation on the subject. The state of the weather was the reason assigned for the failure, and I believe that to be correct, as we afterwards used the material over again very satisfactorily, and a contract was entered into with Mr. Laming to purify the whole of the gas made by the company. Mr. Thompson suggested that we should put the material into the retort-house and warm it; and when we did that, it revived immediately. The failure was due simply to the lowness of the temperature, and I do not think it would have been so had we known as much as we did afterwards, as we then laid out the material in thin layers to ventilate. When it is laid out in the mass great heat is given out, which assists the renovation; but when in thin layers, the process is retarded. I would have used the muriate of iron decomposed with lime in preference to anything yet brought out; and I have told Owen and Co. that the sulphate of iron was a mistake. We have used the hydrated oxide of iron and the renovating process down to the present time, and have not paid the plaintiff a penny.

By Mr. WEBSTER: Mr. Hills' experiments were discontinued on the 1st of October. I am aware that there are various kinds of oxides of iron; that there are some hydrates that will not purify gas, and some anhydrous ones which will, and I have a patent for that very thing.

Cross-examined by the ATTORNEY-GENERAL: I was told by Mr. Laming that the material used by him was muriate of lime and oxide of iron. Muriate of lime is another name for chloride of calcium. The experiment on the large scale commenced on the 20th of December, 1849. It was not an entire failure; and when I told the directors on the 26th of January following that "the material is still in the purifiers, and does its work very partially; in fact, it is now quite useless as a purifying material for the whole of the gas we make," I meant that for practical purposes it was a failure, and I have given my reasons for saying so. It was within a month of that period that our claim for the renovating process was before the Attorney-General, and was resisted. Mr. Hills' specification was published in the month of May following. Our specification was published in October, 1850, and shortly afterwards Mr. Hills commenced proceedings against us by *scire facias*. We attempted to disclaim this portion of our specification, but Sir Frederick Thesiger refused to allow us to do it, and at length judgment was obtained against us, which we thought was a very hard case. Before the patent was obtained, I went before some officer, and made an affidavit that the invention was new; that was the only thing I had to do with it. I can undertake to say that the material which we used at the works between December, 1849, and September, 1850, was the same kind of material as had been put in the small purifier—sulphate of iron and lime; since then Mr. Laming has had a contract with the company, and he sends in what he likes, and I can only suppose that he acts upon his patent. We have tried many experiments since then; we are always experimenting. I am certain that between the 8th of August, 1849, when we commenced trying Laming's process, and the time when Mr. Hills obtained his patent, he was upon our premises twice. He took a great interest in the thing. I cannot tell the exact dates—but that he was there, and that I told him, I have no doubt. It was very soon after the discovery was made that I told him I had discovered the process of revivification, just in the same way that I did to any one else. I cannot undertake to say that any other person was present on the occasion. When Mr. Thompson came to the works, I let out, in conversation on the subject, that I had told Mr. Hills; and Mr. Thompson said, "What a fool you are! he will have it in his patent;" and, in fact, he did. I was a witness on an arbitration before Mr. Rotch, the barrister, in April and May, 1851. I believe Mr. Wonfor was present. I do not recollect saying on that occasion that I had only mentioned this discovery to one of the Mr. Hills, and I did not know which of the two it was. I will not swear that I did not say so; but that I did mention the matter to the plaintiff I am satisfied.

The ATTORNEY-GENERAL was proceeding to cross-examine the witness further on this point, but

Mr. BOVILL objected that no shorthand writer's notes of the evidence given on the arbitration were produced, and therefore it ought not to be argued that the witness did make such a statement.

Cross-examination continued: There is one circumstance which impresses upon my mind the fact that I mentioned this discovery to Mr. Hills, and that is, that we had a very heavy thunder-storm at that time, and I had been to the office in Bridge Street, and on my return found Mr. Hills at the works. That was certainly not on the 27th of July, but in the month of August, after the discovery was made; and that I told him then I have not the slightest doubt. It may be that there was a storm on the 27th of July, and that Mr. Hills was at the works then.

By Mr. BOVILL: I can undertake to say that I told him before the month of November.

By the ATTORNEY-GENERAL: Mr. Laming had an assistant, of the name of Wonfor, who was backwards and forwards at the works.

By Mr. BOVILL: The arbitration before Mr. Rotch was in reference to these matters, and I believe the result was that Mr. Hills was allowed to have the use of hydrated oxides; but after my evidence Mr. Rotch would not allow him to claim the revivification. The material used in August, 1849, was hydrated oxide, and we continued to use it down to the period of Laming's contract. Soon after Mr. Thompson came he suggested the warming of the material in the retort-house, and it then answered effectually. We had not put it into the large purifier when I made my report, because the weather continued so cold.

By Baron BRAMWELL: I think the cold weather would make the same difference with the material which we obtain from Owen and Merten's, if we used it in the same way that we did in those experiments. In cold weather it takes a longer time to revive. We take it out now, and place it upon a ventilating floor, and do not pass air through it. It is not so much spread out as it was, and consequently the heat becomes sensible upon the oxidizing of the material, and warms the mass, thus enabling the process to go on; whereas when we formerly did it in thin layers the heat was dissipated. We failed on the large scale at first, and had to go back to the use of lime.

By Mr. BOVILL: I have read the plaintiff's specification, and I think if we had used his material in thin layers the effect would have been the same. We have adopted the process of reviving by exposure to the air ever since.

Baron BRAMWELL: There is a material question I want to ask you. You say you will not swear that you stated you did tell one of the Mr. Hills, but you did not remember which. Of course, if you do not recollect, that is quite right; but you must admit that it is possible you may have said so. As we cannot suppose you said so dishonestly, you must have made a mistake then or are making a mistake now. If you admit that you might have made a mistake then or now, what reason have you to be certain that, although you may have said something different on a former occasion, you were wrong then and that you are right now?

Witness: I can only say, my lord, that I have had repeated conversations with Mr. Hills upon the subject, and he has always laughed and said I did not tell him; but if I did not, I can hardly believe anything again. I am not certain that I made the statement referred to before the arbitrator.

Baron BRAMWELL: But you admit the possibility of your having done so. It is really a most important question, and if you could remember it would be well. You were speaking more nearly at the date of the transaction when you were before Mr. Rotch.

Witness: My impression is, that I told him I informed both the Mr. Hills. I have only what I told Mr. Thompson to corroborate my statement.

Baron BRAMWELL: May you not have said, "I told one of the Hills?"

Witness: No; I said I told Hills, and every one knew who that was. I told Mr. Thompson that I had done so, and he said I was a great fool. I believe that was in December, 1849, or January, 1850.

By the ATTORNEY-GENERAL: I have received £150 a year from Laming and Co. for a considerable time.

By Mr. BOVILL: I hope to continue to receive that whatever the result of this trial, though I am afraid that if it is decided against Mr. Hills my interest will cease.

Baron BRAMWELL: Why do you receive it? For what consideration?

Witness: The consideration was this: When this discovery was made, it was felt to be one of such vast importance by Laming and Owen that a patent ought to be taken out in our joint names; and it was agreed that I should have a certain sum of money for every ton of coals carbonized. An agreement was drawn up between us, whereby they agreed to pay me ½d. per ton, but that agreement was never carried out, and at last, as they stated the thing was not paying them, I said, "Pay me a fixed sum, and I will let you off and not enforce the agreement," which would have brought me in some thousands a year.

By the JURY: I have not kept a sample of the first material used. I gave one to Mr. Thompson.

A JURYMAN: We have no evidence at present to show what that article was, and I think we should have a sample.

Baron BRAMWELL: I think we have. We have this witness's and Mr. Laming's statements that they used oxide of iron and chloride of calcium obtained by the use of muriate of lime.

Samuel Gibbs, examined by Mr. DENMAN.

I have been foreman of the labourers at the Chartered Gas-Works for eleven years. I was there in 1849, and it was my duty to superintend the work at the purifiers. I saw Laming there at that time. I have heard Mr. Evans's evidence, and as far as I know he is correct. I also remember Mr. Hills' experiments. The material employed by Mr. Laming was like rusty iron borings. It was brought in baskets and carried into the purifiers. When it was taken out it was black, and I recollect its afterwards turning red, and Mr. Evans ordering that it should be put into the purifiers again. This went on for the rest of the summer and part of the following winter. When carried to and from No. 3 purifier the material was taken through this arch. It was about this time that Mr. Hills was there. His brother was there all the time. I have seen him there during the period that this stuff was being carried. It was quite a matter of conversation among the men and the people who came for coke when it began to turn red. There were from 200 to 300 men employed there, and in the winter time 400. Some of the same men that supplied the material to Mr. Hills' scrubber assisted occasionally at the purifiers.

Christopher M'Guire, examined by Mr. WEBSTER.

I have been employed by the Chartered Company fourteen years. I remember the experiments going on at the scrubber by Mr. Hills. I was employed there and saw Mr. Hills. He gave me a half-crown for some beer one day, about the month of August. The stuff in the bags was going in at the time. I helped to fill the scrubber for Mr. Hills, and had been employed at the purifier before that. It was well known about this material by every one that passed that way, and several persons stopped and took some up and put it to their noses; it was a curiosity like.

Dr. *William Odling*, examined by Mr. BOVILL.

I am a physician, a member of the College of Physicians, and professor of chemistry at Guy's Hospital. I have paid considerable attention to the process of gas manufacture, and have frequently been consulted by the Government about gas-works. My attention has been called to this subject for four years past, and to chemistry for many more years. Prior to 1840 it was well known that hydrated oxide of iron would absorb sulphuretted hydrogen. I have a copy of Croll's patent. With the knowledge which was common to chemists in 1840, I should infer from that patent that the term, "oxides of iron," would include both hydrated and anhydrous; and if I had had to try the experiment, I should certainly have selected the hydrated, from my knowledge that that was most likely to succeed. It was not known to me at that time, nor I believe to any one else, that anhydrous oxides would absorb sulphuretted hydrogen. I have made investigations and experiments subsequently, the results of which have shown that there are certain kinds of anhydrous oxides that will purify gas. I agree with Dr. Taylor and other gentlemen that there are some hydrated oxides which will not do so. I have heard the evidence of Mr. Croll, and, referring to the process which he describes as having been used by him at the works at Brick Lane, I should certainly say the material employed was hydrated oxide. As a matter of opinion, I should say that after that material had been used and placed over the retorts, with a heat of from 400° to 600°, in the open air, it would still be hydrated; it might be partially hydrated and partially anhydrous, and from my experience I should judge that so prepared it would continue to purify gas from sulphuretted hydrogen.

By Baron BRAMWELL: I believe the anhydrous oxide in the mixture, if there were any, would purify; that is my experience with other anhydrous oxides. I feel quite certain that, practically, oxide of iron treated as Mr. Croll states would purify gas. There are few that will not purify to a certain extent.

By Mr. BOVILL: Referring to Mr. King's evidence, I am quite certain, from my experience, that hydrated oxide of iron used for the purpose of gas purifying, and then brought to a red heat, would again answer the purpose. I have experimented with some of Mr. King's own material, and made it red-hot myself. There is no difference between the material which Mr. Croll swears he used and the oxide which Mr. Hills describes, so far as relates to the presence of hydrated oxide in each, and no difference at all as far as respects their effect upon the sulphuretted hydrogen. When Mr.

Hills' mixture is prepared in the way he describes, with sulphate of iron and lime, there is no difference in the substance produced, in the mode of its action, nor in the effect produced.

Baron BRAMWELL: I have no doubt that nature treats both these gentlemen alike, and does not show a preference to one over the other.

Mr. BOVILL: If it is admitted that it is so, I will not press the matter further.

Baron BRAMWELL: You should bear in mind this: the plaintiff says, I use hydrated oxide of iron for the purification of sulphuretted hydrogen, &c., and he does not tell you whether he separates it from any other matter or not.

Mr. BOVILL: He says he either uses it alone or mixed with sulphate of lime, or sulphate or muriate of magnesia, potash, or soda, or in conjunction with any other purifying material at present in use for a similar purpose.

Examination resumed: If heated to a red heat, it would still purify.

By Baron BRAMWELL: It would not then continue a hydrate, but it would purify gas equally as well.

By Mr. BOVILL: It appears to be more a question of the molecular condition of the oxide than a question of hydration at all, upon which the purifying power depends. I am acquainted with Laming's patent. In 1847 hydrated oxide of iron was commonly known by the name of carbonate of iron; that was one of its names—the one by which it was most commonly known. Sometimes it was called oxide of iron and sometimes iron rust. The common iron rust is hydrated oxide of iron, and it was called carbonate in the Edinburgh and Dublin pharmacopœias. I am acquainted with the *London Pharmacopœia*. In the edition for 1847, there is a description of what was then called sesqui-oxide of iron. The mode of preparation is precisely the same as when before it was called carbonate.

Baron BRAMWELL: I must say that I think this is a most unprofitable inquiry. I understand the drift of this is to show that Laming was, in truth, speaking of oxide of iron when he called it carbonate. Is it not so?

Mr. BOVILL: That he meant the material which passed under the name of a carbonate.

Baron BRAMWELL: Is not your object to show that Laming in his specification must be taken to speak of an oxide when he speaks of a carbonate?

Mr. BOVILL: That he must be taken to mean that which was commonly known as a carbonate.

Baron BRAMWELL: And which is an oxide?

Mr. BOVILL: Yes.

Baron BRAMWELL: What does that matter, when we have the thing itself described in such a way that we know what it is?

Mr. BOVILL: The reason is, that the law requires that, if there are two names to a thing, and here there is—one a scientific——

Baron BRAMWELL: But you do not follow me. Supposing a man had said, "I use a thing which I think proper, and do call *Abacedabara*," what would it matter whether it was the right name or not, if the thing were described there? That thing by any other name would operate as effectually.

Mr. BOVILL: I do not know what may happen in this case, and I am anxious to have upon your lordship's notes two or three facts which are contradictory to the evidence on the other side. If the evidence which they have given upon this subject is to have any influence on the case, I want conclusively to answer it.

Baron BRAMWELL: If you will show me the relevancy of the inquiry, I will take it down willingly; if not, I will take it down unwillingly.

Mr. BOVILL: It was decided in the case of *Savory v. Price*, where the plaintiff had a patent for making a neutral salt or powder possessing all the properties of the spring at Seidlitz, that it was the duty of a patentee to specify in the plainest language the most easy way of producing that for which the patent was granted, so as to make the public fully acquainted with the mode which he himself adopted; and the court remarked, that by reading that specification the public would be led to suppose that a most laborious process was necessary for obtaining the ingredients, whereas, in fact, they could go to a druggist's shop and buy them readily.

Baron BRAMWELL: It is as though a man having taken out a patent for making bricks should specify that it was necessary to take aluminum, to oxidize it, then take that which results and form a brick; whereas he ought to have said, in the first instance, get your clay, and then make bricks. In like manner the people who took out the patent you refer to, instead of describing a laborious process for obtaining the ingredients, should have said: Take tartaric acid, Rochelle salts, and carbonate of soda, mix them together in certain proportions, and you will have an imitation seidlitz powder. But what has that got to do with the present inquiry, where, in the first place, the question is (and I do not hesitate to say now that the spectre of that case is removed from before me), that, in point of law, a man is bound in his specification to use the proper, true, scientific terms? But, in the next place, I say it matters not in the present case whether he has or not, because he has told you what the thing is. Suppose he had left out the name?

Mr. BOVILL: But it is material that I should give this evidence in relation to what the substance is.

Baron BRAMWELL: Go on, Mr. Bovill. When you have done, I shall repeat to the jury what I have said. What can it matter whether, if the specification shows the plaintiff's invention, he calls it by a wrong name? There is the thing.

Mr. BOVILL: That is what I am endeavouring to impress upon the jury; but I have to answer the case on the other side, and I know we shall hear by-and-bye that a carbonate is different to an oxide.

Baron BRAMWELL: No; the Attorney-General will say that the carbonate spoken of there is a real, true carbonate; for though it has been proved that by more or less exposure to the air it will become a hydrated oxide of iron, yet by reason of its mixture with the other materials here described, the process of oxidization is so slow that it continues a carbonate until the time it is brought into action; whereas my own client shows the use of a thing which at the outset is an oxide. I have so confident an opinion upon this matter that I have a reluctance to hear any gentleman say that carbonate of iron is an oxide.

Examination resumed: The mode of preparation was exactly the same, and the article produced in each case hydrated oxide of iron. At the present hour, if you were to go to a first-rate chemist's shop in London and ask for carbonate of iron, you would get hydrated oxide. I have got some here which I bought in that way.

Baron BRAMWELL: You got what you did not ask for.

Mr. BOVILL: If all the evidence on the other side is struck out, I will not go on with this.

Examination continued: These are specimens from Squires and Bells', two of the first chemists in London, and they are pure oxide of iron—at least 95 per cent., which is commercially pure. There are shops where you will not get the hydrated, but the anhydrous oxide; but, as far as my experience goes, the first-rate chemists serve you with hydrated oxide only. In the laboratory, where one may take every possible precaution, it might be possible to get a partially pure carbonate of iron, but never absolutely so; and it is not practicable to get it in a dry powder. The contents of the bottle produced here yesterday were not pure carbonate: they smelt of gas liquor and tar. If kept wet, and means are taken to prevent the absorption of oxygen, it may be preserved for a considerable period of time, but it cannot be kept dry. In some of the processes which Laming employs, he throws down an oxide at once, and not a strict carbonate at all; that is where he precipitates muriate of iron by means of lime or of chalk, "when the latter will suffice." The lime does not contain carbonic acid, and even when he uses chalk he does not get a carbonate.

By Baron BRAMWELL: In using the word "carbonate," therefore, he has used a term which is strictly incorrect.

By Mr. BOVILL: In another part of his specification, I find another mode in which a strict technical carbonate is thrown down, and not an oxide—that is, when he uses ammoniacal liquor, he produces a mixture of true carbonate, and a sulphuret of iron when first thrown down. Hills, in his specification, calls one of the materials hydrated or precipitated oxide, but, although he does so, I find that some of the processes by which that material is produced would, in strict technical language, throw down a carbonate. The term "soda" in his specification I should, with my knowledge of the subject, read as carbonate of soda. Oxide of manganese answers excellently for purifying gas. I have not tried whether it will do so after having been brought to a red heat. Sulphate or muriate of iron may be decomposed by chalk without heat, and will be precipitated, though not immediately. I have tried the experiment, and it is in the books. It is a gradual process, and in the result it produces oxide of iron. I cannot find in Laming's specification any reference to heat in connexion with the decomposing of muriate of iron by lime. If applied, it would make an alteration in the result—one process would produce a hydrated, and the other an anhydrous oxide. You can make it answer without heat if you like, and, from actual experiment, I can say that, if prepared according to Mr. Laming's specification, it will answer. It depends upon the rapidity with which you pass the gas through the material, and the amount of pressure on the gas. If you pass it through rapidly, there is no effect. I have tried it, and can make it purify or not, as I please. Supposing gases to be absorbed by hydrated oxide of iron, the taking off the atmospheric pressure would not remove them. There is no means of removing them, because they are in chemical combination.

By Baron BRAMWELL: The placing of the material in a vacuum would not do it, because the gases no longer exist as such; they are destroyed by the chemical combination. If absorbed by porous bodies, such as sawdust, charcoal, &c., which do not act chemically, they would be removed. Any person seeing material in gas-works turn from black to red, would be almost sure to conclude that it was either carbonate or oxide of iron. I think very likely if chloride of calcium were mechanically mixed with the material, it would retard the process of oxidization. I find the same things both in Hills' and Laming's; but I do not find that he claims distinctly the use of chloride of calcium, though he mentions the very materials by which it is produced. I agree with Dr. Miller that the materials would be precisely the same, in the same proportion, to produce oxide of iron or chloride of calcium.

By Baron BRAMWELL: You could procure a true hydrated oxide of iron unmixed mechanically with another substance, though by any of the processes which Hills describes you could not do it practically, unless some further process were adopted which is not described. That process is a well-known one, but I infer that in some cases it is not used. When he had got by any of his processes, hydrated oxide and muriates or sulphates of lime in mechanical mixture, he could, in some cases, separate the two easily; in others he could not do it at all in a commercial point of view.

By Mr. BOVILL: So far as the oxide of iron is concerned, the effect upon the sulphuretted hydrogen would be the same, whether the muriate of iron were decomposed by lime or magnesia. They would be in the same deliquescent condition, and their effects would be precisely similar.

Mr. BOVILL: As you are acquainted with both these patents, I ask you, as regards the use of hydrated or precipitated oxides of iron, is there any difference between Mr. Hills' and Mr. Laming's?

The ATTORNEY-GENERAL rose to object to the question. This is really—he said—asking him to answer the whole question before the court.

Mr. BOVILL: Then I will ask the jury.

Cross-examined by the ATTORNEY-GENERAL: In Hills' process for decomposing muriate of iron by lime, the product is oxide of iron and chloride of calcium; the latter may be got rid of very easily. Not so with the sulphate—but then there is a porous body with the mixture. I have never tried Laming's patent upon a large scale for a long time together, in the same way that it would be used by gas companies. I have never seen a pure carbonate used. Until the last twelve months I did not know that anhydrous oxides would absorb sulphuretted hydrogen; and therefore, if I had at the date of Croll's patent gone through the process he describes with oxide of zinc, &c., I should have used hydrated oxide, because, as an abstract proposition in chemistry, I knew that that would absorb the impurity. If that material had been afterwards removed and roasted as he describes, it would certainly have become anhydrous. Reading his specification I should infer that he meant a "red heat." I have never tried his process on a large scale in the actual purification of gas. I have made experiments at the Chartered works, at the London Gas-Works, and in my own laboratory. I took the crude gas and passed it over some of these substances, and then ascertained whether, having done so, it still contained sulphuretted hydrogen. I have used peroxide of manganese, I have used some of the stuff which Mr. King gave me, and I have used several varieties of anhydrous oxides which I myself prepared. I used them in a glass vessel about two feet in height. I went through the subsequent process described for renovating the material by heating it, and the mass became thoroughly red from the ignition of the sulphur. I had been making experiments at intervals from the three weeks or a month before the trial at Guildhall until now. I have seen Mr. Hills' process tried on a large scale and according to the specification, and I have also tried it myself. I have seen it tried systematically at the Imperial Gas-Works, at Hackney and Fulham.

By Mr. BOVILL: My experiments have been sufficient to satisfy my mind as a scientific chemist, and they were conducted with that view. I have no doubt about the same results being produced when tried on a large scale; moreover, there are records of their having been so done. Oxidization never goes on so rapidly in cold weather as in warm. The renovation of oxide of iron after being charged with sulphuretted hydrogen was well known to chemists before 1847.

Dr. *Thomas Richardson*, examined by Mr. DENMAN.

I am an analytical chemist, and reside at Newcastle-upon-Tyne. I have been engaged in the practice of chemistry upwards of fifteen years. I have turned my attention to the question of the purification of gas, and having

heard the evidence given by Dr. Odling on the subject, I say that I agree with him substantially. I was present at the time Mr. Laming tried some experiments with chalk and lime (having the specification before him), the day before yesterday and yesterday. They were successful, and the results were shown to Mr. Herapath.

Cross-examined by Mr. HINDMARCH: The quantities of the materials made use of were three or four ounces. I dissolved the iron in muriatic acid, and diluted that with about its own body of water. I then got the muriate of iron in solution, and mixed that with the chalk, using an excess of chalk in order that I might subject the process to as severe an ordeal as possible, because an excess of chalk would not facilitate the subsequent decomposition. The chalk was used in equivalent proportion to the quantity of iron dissolved in muriatic acid. I tested it this morning, and I could scarcely discover a trace of iron in the solution; so that practically the decomposition was complete. It was a neutral solution, so that there was no excess of acid. This experiment was commenced last night at nine o'clock, and finished this morning at nine. The operation would have been much quicker if the muriates had been in proper proportion.

By Baron BRAMWELL: I mean, so as to have no chalk "unmuriated." I think if the preparation had been mixed in strictly atomical proportions, the process of decomposition would have been quicker; but I wished to subject the matter to as severe an ordeal as I could.

By Mr. HINDMARCH: I have read Laming's specification. If you make use of magnesia and the carbonate of iron, and use that in the purification of gas, it would depend upon the quantity passed through whether, after the first operation, the magnesia became carbonate of magnesia. It also depends upon the quantity of water used whether or not it is a porous body; if a large quantity is not used, it will be.

By Mr. BOVILL: If used in proportion to the iron, it would not be for practical purposes.

Baron BRAMWELL: I am lost here. He has taken us into magnesia, which is a long way from Guildford. Just explain to me the bearing of the point in hand.

Mr. HINDMARCH: It is to show that magnesia has nothing to do with the question, because it has nothing to do with Laming.

Baron BRAMWELL (to the jury): I hope you understand this gentlemen, for I do not.

Lewis Thompson, Esq., examined by Mr. WEBSTER.

I am a member of the College of Surgeons, and am also a consulting chemist. I was engaged with Mr. Laming in Paris in 1847, and the object of our pursuit was the manufacture of ammoniacal salts from the gas liquor of Paris; and in that manufacture we produced a considerable quantity of metallic oxides, carbonates, and sulphates. When I first joined Mr. Laming, we were in the habit of throwing away this gas liquor as a waste body. It consisted of the sulphuret of manganese, the sulphate of manganese, and the hydrated sesqui-oxide of iron. It occurred to us to endeavour to utilize these substances, and accordingly we commenced certain experiments in the gas factories of Paris, and the result was to induce Mr. Laming, in or about the month of October or November, to proceed to London in order to take out a patent, leaving the care of the manufactory and also the experiments to myself. On his return, and as soon as we had secured his invention, we began on a large scale, at two or three of the works, to purify the gas made there. At this time the revolution which dethroned Louis Phillipe commenced, and I found it perfectly impossible to stay in Paris. I therefore left Mr. Laming towards the latter end of February, 1848, and on my return to London I was engaged by Mr. W. Hawes.

Baron BRAMWELL: Come, Mr. Thompson, get on.

Witness: I am getting on slowly, my lord.

Baron BRAMWELL: Rather be like a hydrated precipitate.

Witness resumed: Mr. Hawes was partner in the large brewing firm of Thorne and Co. immediately adjoining the Westminster Gas-Works, and the son of Mr. Hawes, the deputy-governor of the gas company. The circumstance of the discovery made by Mr. Evans had been mentioned to him, and he came over to me one day and said, "Something very singular has occurred at the gas-works; they tell me the material will do over again. Come over and tell me what it is." That must have been in the month of August, 1849. I went over, and Mr. Evans pointed out the material to me. He took me down to the place which I recognize on the model, and showed me there a quantity of red material, which he told me had been used in the purifier three or four times, and that it continued to purify the gas after it had become foul, by simply exposing it to the action of the atmosphere. He told me that it had been given to him by Mr. Laming, and, as I took a considerable interest in the question, I begged him to allow me to have a portion of it. I took some of that material away, and I analyzed it. I have here, in this book, an analysis of the composition which was thus being used. The date of that analysis was Sept. 7, 1849. It is as follows:—"Laming's stuff from gas-works, Sept. 7, contains hydrated oxide of iron 22 parts, carbonate of lime 6 parts, sulphate of lime 7 parts, sawdust with sulphur 37 parts. These were the insoluble constituents. Those soluble in water were—sal ammonia 10 parts, and muriate of lime 18 parts;" thus making up the 100 parts, and I observe at the end of this there is a note that the material had been used in the purifiers four times. From my knowledge of Laming's patent and this analysis, I was perfectly satisfied that this material consisted originally of muriate of iron, mixed with lime and sawdust. Mr. Evans explained to me at the time the process of revivification, and I left the works, and did not go there again or see him for some months afterwards. I remember saying to him when I parted from him in August, "It is a pity you did not take out a patent for this invention." Mr. Laming mentioned to me during the course of the ensuing winter, which was a remarkably severe one, that the material would not revive—that is to say, the sulphuret of iron contained in the mass would not oxidize, and I went to the works to see it. This was sometime in the month of December of the same year, and I found that the temperature of the air was sufficiently low to solidify or cause the muriate of lime or chloride of calcium contained in the mass to crystallize, and so close and hermetically seal up the particles of sulphuret of iron which had been formed. Under these circumstances, I suggested the application of heat to thaw the crystals of chloride of calcium. This advice was adopted on a small scale, but it was impossible to adopt it with the large purifiers—the mass was too large, and there was no apparatus that could be employed. But portions were taken out of that purifier and carried into the retort-house, the temperature of which, being exceedingly warm, thawed the crystals, and immediately the matter, which had been black, began to become red; and it was then placed in the small purifier, and found to answer the purpose again properly. The partial failure at that time, therefore, was merely owing to the extreme lowness of the temperature. I have not noticed so low a temperature since that winter. On that occasion I again spoke to Evans about the propriety of joining with Laming in taking out a patent for this invention, and he then told me that he had communicated the fact to Mr. Frank Hills, of Deptford. This must have been some time in the month of December, 1849—within a week, more or less, of Christmas. I told him I was rather vexed with him, and that he had been a great fool, and that he had thrown away the only chance he had of getting a patent for it; because I was well aware that several persons were in the habit of keeping open what is technically called a "fishing patent," into which almost any invention of that kind could be introduced, and that I was afraid Mr. Hills might be induced to do. My attention has been called to Laming's and Croll's specification. That part of Mr. Hills' patent wherein he proposes to claim hydrated sesqui-oxide of iron alone, and unmixed, is identical with that part of Croll's wherein he speaks of the use of what he calls "oxides of iron." After hydrated oxide of iron has been employed to purify gas, and then exposed to a red heat to get rid of the sulphur, it will answer the purpose of purifying again. I have tried it practically. The process described by Mr. King as going on at Liverpool is identically the same as that part of Mr. Croll's process where he speaks of the roasting; with this exception, that Mr. King in the first instance distils the sulphur from it, so as to obtain that sulphur which Mr. Croll wastes. I have a piece of that sulphur here. [Produced.] As far as regards the purification of gas, the two processes are substantially the same. The oxide, after being heated, becomes anhydrous, but it will still do for the purpose, and there is a patent in existence for the process. I agree with Dr. Taylor that this has reference more to the molecular state of the oxide than to the question of its being hydrated or anhydrous; in fact, nearly six years ago I wrote a paper on that subject, showing that it did arise from a peculiar molecular condition, which it would impossible in language to give any description of. By asking for carbonate of iron at chemists' I have obtained oxide of iron. I have obtained from Apothecaries' Hall a great variety of oxides, the greater number of which will purify, but some will not. In April, 1850, I remember that I made a statement to the Society of Arts in reference to this matter.

Mr. WEBSTER was about to read the paper, but

The ATTORNEY-GENERAL objected that it was not evidence, and

Baron BRAMWELL ruled that it was inadmissible.

Examination resumed: That particular combination in Hills' patent in which he makes a mixture of magnesia and muriate of iron, and which therefore consists of muriate of magnesia, would crystallize exactly in the same manner by extreme cold as the muriate of lime contained in Laming's preparation. I have tested that fact by direct experiment. They both crystallize, and therefore hermetically seal up the particles of the sulphuret of iron.

Baron BRAMWELL: If I understand rightly, Hills' speaks of using lime.

Witness: Yes; but I infer from the fact that he says purposely that he excludes the muriate of lime from his preparation, that he must remove the chloride of calcium away. He does not say so.

Baron BRAMWELL: On account of his negative statement, "I do not claim," &c.? I understand you.

Cross-examined by the ATTORNEY-GENERAL: If I were left to infer from Croll's patent what he meant, I should say it was a hydrated oxide of iron, because the manganese which he points out as a metal is a hydrated oxide. For the second use it would be anhydrous; and hence it is that I am able to give a meaning to his use of the word "oxides." No kind of process would substantially and permanently be successful in practice, if the oxide could only be used once, because there is nothing in the shape of purifying material cheaper than lime. I am not a gas engineer, but I am consulted by gas companies frequently, and in that sense I can say that I have seen in the last six years a large quantity of gas purified by anhydrous oxide of iron. At one of the Liverpool stations a large quantity is so purified—probably, at the present time, a third of the total quantity manufactured. That has been going on for a year and a half now; it is a practical operation constantly going on, but without reference to the books of the company it would be impossible to say the actual quantity of gas so purified. The preparation of the substance in the first instance was by mixing together two parts of common copperas or sulphate of iron, and one part of slacked lime, and these were ground together in a mill into a kind of paste. The mass was then rolled into the yard, where the air acting upon it converted it into sulphate of lime and hydrated sesqui-oxide of iron. It was then reduced to a powder, and after being sifted, was placed in the purifier. In the purifier it was subjected to the action of the foul gas, by which the oxide of iron became converted into sulphuret of iron; and this again, by exposure to the air, was reconverted into oxide of iron, with a deposition of sulphur in the mass. This was continued for about twenty-eight times, and it was then found that from the accumulation of sulphur, which amounted to 40 per cent., they could no longer put the same material in the purifier, it being half as large again as it was originally. It was necessary then to roast off the sulphur, and that was done in an oven. The material was, therefore, a hydrated oxide of iron for the first twenty-eight times; then we placed it in a furnace in such a situation as that the air might play over it, and burn away the sulphur. That the material became red-hot, there is no question. It was then moved about, and afterwards thrown out to cool in the open yards. Afterwards, it was moistened with water and placed in the purifiers. I analyzed a sample, and found it to consist of anhydrous oxide of iron and anhydrous sulphate of lime. After it had been again used to purify gas, we merely exposed it to the air as before, and allowed it to revive in the same way. It remains permanently anhydrous. I have no record of the fact, but it must be a year and a half or two years since we began to try that process, and I believe the same material is still in use. It is necessary to add some fresh portions from time to time, as it gets wasted by the workmen spilling it about. The waste is supplied with anhydrous oxide, as Mr. King keeps a separate account of—as he expresses it—the "burnt" and "unburnt" material. One of the stations is almost entirely supplied with the anhydrous, and in a short time nothing else will be used, except what is necessary to supply the waste. At the Westminster works, the failure which has been referred to arose, as I have stated, from the dense solution of muriate of lime, or chloride of calcium, crystallizing exactly as I have found it do in Hills' preparation, which contains chloride of magnesia. It was I that suggested, as a remedy, to warm the material. I infer that it must have been at the end of August that Evans first communicated to me the discovery of the renovation, because I find that I analyzed the material in the beginning of September. It was in December or January that Evans told me he had mentioned the matter to Hills; he said nothing about it in August. It was at the time I suggested to him to take out a patent.

By Baron BRAMWELL: Whichever of these mixtures—the muriate of lime or chloride of calcium—is used, it is the iron solely that takes the sulphur from the sulphuretted hydrogen; the lime, whether it is a sulphate or a muriate, has nothing to do with it.

Baron BRAMWELL: If it operates at all, *cæteris paribus*, is it useful as a medium?

Witness: Not in that sense.

Baron BRAMWELL: Is it useful to take away the ammonia, supposing that has not previously been removed?

Witness: It removes the carbonate of ammonia from the foul gas.

Baron BRAMWELL: Is it ever, or could it ever be, an advantage to use the hydrated oxide separate from the lime, whether it be the muriate or the sulphate, having previously purified the gas from ammonia?

Witness: There would be no advantage, and you would have to employ two vessels instead of one, which would be an inconvenience. It would be a disadvantage to use them separately, even if by some chance you got them separate.

Baron BRAMWELL: Is it practicably procurable in a separate state?

Witness: I think there are preparations of it which are quite sufficient.

Baron BRAMWELL: If you got the hydrated oxide naturally which would purify, it would be better not to mix it with any form of lime, but to get rid of the ammonia first, and afterwards to use the pure or separated hydrated oxide?

Witness: Pardon me, my lord, there would be an advantage in mixing it with some other materials, for the purpose of arresting in the same vessel the whole of the impurities of the gas—some salt of lime—and thus get rid of the sulphuretted hydrogen and the ammonia in one vessel and at one operation.

By the ATTORNEY-GENERAL: I never saw Mr. Laming's French patent until sometime after I spoke to Mr. Evans about taking out a patent; and then, in consequence of a dispute between those gentlemen as to who was the author of this invention, Mr. Laming showed me a copy of this paper. I did not believe he had got a patent in France until he showed it to me.

By Baron BRAMWELL: You may decompose some portion of manganese, iron, or zinc, by means of chalk or lime, but chalk will not decompose muriate of manganese. Lime will decompose muriate of iron. In decomposing muriate of lime, the protoxide will be a hydrated oxide, and that, when mixed with sawdust, will purify gas. That is precisely the preparation that was used at Westminster. If any one supposes that it is the chloride of calcium that takes away the sulphuretted hydrogen, he makes a mistake; and if he says, "the oxides or carbonates which result need not be removed," he simply says—you need not remove that which alone does good.

Baron BRAMWELL: So that whoever wrote that attributed the beneficial result to the wrong cause. Is there any difference between the action there described and the action of which Hills speaks, when he says, he takes the hydrated oxide of iron mixed with sulphate of lime?

Witness: There would be no difference so far as the sulphuretted hydrogen was concerned.

Baron BRAMWELL: Muriate of lime alone is mentioned by Laming, it is not mentioned by Hills?

Witness: No, not at all—except to be excluded.

Baron BRAMWELL: But he uses "sulphate of lime, or sulphate or muriate of magnesia, baryta, strontia, potash, or soda." If he had used the word *lime*, then would the two things be identical in their operation?

Witness: Identically the same.

Baron BRAMWELL: And if Laming had put in "sulphate of iron," would the two things have been identical?

Witness: Exactly the same.

Mr. BOVILL called attention to Laming's patent, page 5, line 25.

Baron BRAMWELL: There he mentions *sulphate* of iron, but does not mention lime; where he does mention lime, he mentions *muriate* of iron. (To witness:) Sulphates are equally efficacious for purification from carbonate of ammonia, and the oxides which result for the sulphuretted hydrogen?

Witness: Precisely; the effect in the same, and the renovation of the oxides equally as easy in both cases.

Baron BRAMWELL: Is the preparation made from muriate of iron and ammoniacal liquor equally easy of renovation?

Witness: I am not aware that there is any preparation in which ammoniacal liquor is employed, except where you collect the precipitate, and in that case you get a pure hydrated sesqui-oxide of iron, and that revives with equal facility to the oxide prepared with lime.

In answer to further questions by the learned judge, witness said: I heard what Evans stated respecting the loss of heat by the material being spread out. The crystallization does not occur until the thermometer falls to about 20° Fahr., which is a very rare occurrence.

By Mr. BOVILL: Hydro-sulphuric acid is the same thing as hydro-sulphuret of hydrogen.

W. Herapath, Esq., examined by Mr. DENMAN.

I reside at Bristol, and have for many years been engaged as an analytical chemist. I have heard the evidence given by Dr. Odling in this case, and I agree in the opinions he has expressed. There is no qualification or addition which I wish to make. It was published to the world as early as 1839 by Berzelius, that both hydrated and anhydrous oxides would absorb sulphuretted hydrogen.

Baron BRAMWELL: That is what we have not heard before.

Mr. DENMAN: That is the reason I asked the question.

Baron BRAMWELL: And a very good reason too. I wish it was always borne in mind.

Examination resumed: I believe attention was not much called to the subject until the occasion of Croll's patent. I have heard Mr. Thompson's statement of his analysis of Laming's stuff, and I have no doubt it was sulphate or muriate of iron decomposed with lime and mixed with sawdust, and which had been used for the purification of gas from sulphuretted hydrogen. I have seen Mr. King's material, and analyzed it. There is a considerable quantity of free sulphur in it, and the compound, after being heated to a red heat, is perfectly anhydrous. You could not easily reconvert it into a hydrate without solution and precipitation. The mixture of chloride of calcium does not at all affect the absorption of *sulphuretted* hydrogen; it is used to absorb the *carbonate* of ammonia. The freezing of the air would have the same effect upon the magnesia used by the plaintiff in preventing or retarding the process of oxidization, if it were in the same state of solution.

Cross-examined by the ATTORNEY-GENERAL: The mode in which the oxides act in absorbing the hydrogen is by an exchange of principles—the sulphur goes to the iron, and the oxygen goes to the hydrogen and forms water. The water is not concerned in the decomposition, and therefore the same effect is produced with the anhydrous oxide. There is oxygen and iron—there is hydrogen and sulphur; the hydrogen goes to the oxygen to form water, and the sulphur to the iron. The sulphur may become fixed or not, according to the temperature. I have not tried the experiment of purification on a large scale, as in Bristol; the gas companies use sulphate of lime. The native black oxide of manganese is not anhydrous; it always contains water. [Witness was interrogated on some passages in Graham's chemistry, as to the different kinds of native oxides of manganese.]

By Baron BRAMWELL: I agree with Mr. Thompson that it would be better to take out the two impurities from the gas at one operation. If you do not diminish the action of the lime or the oxide, it would be beneficial rather than otherwise to use them together.

Mr. *Alfred King* recalled, and examined by Mr. BOVILL.

I first began to use anhydrous oxides in the latter part of 1856, and it has been uninterruptedly used to the present time. At one of our stations it has been entirely so for the last month. It is an experiment on a large scale, and it continues to work well.

Professor *Theophilus Redwood*, examined by Mr. WEBSTER.

I am a professor of chemistry. I have heard the evidence of Dr. Odling, and I agree in it generally. My attention has been practically called to these specifications, and I consider that virtually the process of purification disclosed by Mr. King, is the same as that referred to by Mr. Croll.

Baron BRAMWELL: Well, it is not, with all submission.

Witness: I say virtually, in all essential respects.

Baron BRAMWELL: There is as much virtue in "virtually" as in an "if."

Examination resumed: I think, as there are some hydrated oxides which will, and some which will not purify gas, the statement in Mr. Croll's patent of "oxides" is the most correct that could be specified. There is only one oxide of zinc generally acknowledged—some chemists admit another.

Baron BRAMWELL: It is curious that Mr. Croll uses the expression, "The same effect may be produced by the *oxide* of zinc and the *oxides* of iron."

Examination continued: So far as relates to the purification of gas by the oxides of iron, there is not, to my knowledge, anything disclosed in Hills' specification which is not in Croll's, that would add at all to the practical information of a gas manufacturer. I think Hills' is more limited than the other, because he confines himself to one kind of oxide, and Croll uses both. With reference to Laming's patent, I think the presence of chloride of calcium would not be any impediment to the purification of gas from sulphuretted hydrogen by metallic oxides. Mr. Laming proposes to precipitate by gas liquor, and Mr. Hills by hydro-sulphuret of ammonia, which is substantially the same process; indeed, the only hydro-sulphuret of ammonia that could be used in a manufacturing process would be gas liquor.

Cross-examined by the ATTORNEY-GENERAL: If "the oxides or carbonates which result" in Laming's process were removed, the remainder would not purify gas from sulphuretted hydrogen. I believe there is nothing in his patent for getting rid of that impurity but the metallic oxides. The chloride of calcium takes out the carbonate of ammonia, which is a very important matter in the purification of gas. If, by any previous process, the ammonia were removed, the chloride of calcium would be of no use. As I understand it, Mr. Laming specified for the use of metallic oxide *with* chloride of calcium, because the oxides alone had been previously patented by Mr. Croll. I have never, of my own knowledge, been aware of Laming's process being used upon a large scale in gas-works. I am informed that it is in operation at the Chartered Gas-Works. I saw that operation, and was informed that the material was supplied by him. That was in 1856. The oxide of manganese is both hydrated and anhydrous. We always, in using it for the preparation of oxygen, which is the purpose to which it is applied in the laboratory, endeavour to get that which is anhydrous, as water interferes with our operations. I may have said on the last occasion that "the oxide of manganese is anhydrous." If there were a considerable excess of lime in the material, the purification of gas would not go on so quickly, in so far as it would dilute the oxide of iron. I should consider it objectionable, though the lime itself will purify. If in considerable quantities, the purification might be due to that.

Baron BRAMWELL: What is the meaning of this expression in Laming's patent—"I claim also the use of muriates and sulphates of iron, prepared by absorbing a strong solution of these salts respectively into sawdust, as explained with respect to the chloride of calcium," &c.?

Mr. BOVILL: Dr. Odling tells me they are other purifiers, but have no connexion with this mode.

Baron BRAMWELL (to Mr. Laming): Had you any notion that muriate or sulphate of iron, prepared in that way, would *simpliciter* purify gas from sulphuretted hydrogen?

Mr. *Laming:* They will purify gas wholly from ammonia and partly from sulphuretted hydrogen.

Baron BRAMWELL: That will do. You seem to me to have drawn your specification very badly, so far as I can judge.

Robert Warrington, Esq., examined by Mr. WEBSTER.

I am the chemist at Apothecaries' Hall, and have been there for more than sixteen years. We sell the carbonate of iron in large quantities, under the present name, sesqui-oxide. The *Pharmacopœia* is our guide for nomenclature. Carbonate of iron was the language of the *Pharmacopœia* for many years, and it is still called so by practitioners educated during that period.

Baron BRAMWELL: And knowing no better.

By Mr. WEBSTER: We have it prescribed constantly, and always supply the sesqui-oxide. We do not sell it much to chemists and druggists, as they get it cheaper elsewhere. My attention has been called to these specifications; and, looking to the expression in Croll's, "oxides of iron," I think that would include all that were known. The known oxides consist of hydrated and anhydrous, some of which will purify, and some not. I have heard the evidence of Dr. Odling and Mr. Herapath, and I agree with them in their statements.

Cross-examined by the ATTORNEY-GENERAL: I should not know what to call this substance (a bottle previously handed in).

Baron BRAMWELL (to Mr. Campbell): Did you make this substance in the bottle according to Laming's specification?

Mr. *Campbell:* I did. I took muriate of iron, and added gas liquor to it, and allowed it to precipitate. I then drew off the liquor, and I think it was washed once or twice with water. It still has a smell of gas liquor, as it would have unless thoroughly washed. It was on the 31st of December, 1856, when that was made.

Baron BRAMWELL: It ought to have been carbonate of iron when first made?

Mr. *Campbell:* It ought to be carbonate, and is carbonate.

Baron BRAMWELL: Would washing tend to oxidize it?

Mr. *Campbell:* Yes. Gas water always contains a quantity of free oxygen.

Baron BRAMWELL: Would that alter its carbonic qualities?

Mr. *Campbell:* It would take away a little carbonic acid. By putting it in a bottle the top gets oxidized; the rest remains a carbonate.

Baron BRAMWELL: Then there is no controversy about it; because, if you keep it from the air, it continues a carbonate.

Mr. BOVILL: Has it ever been dried?

Mr. *Campbell:* No, never; simply put into the bottle, as it is now.

Cross-examination of Mr. *Warrington* continued: We supply the article, sesqui-oxide, to the Navy and the East India Company. There is rarely any carbonic acid in it—not more than 2 per cent. when dried and fit for

sale. The great bulk of that which is made for sale has been heated to redness, and contains not a trace. As a first precipitate, it is exposed to the action of the atmosphere. We wash away the whole of the sulphate of soda till the water is free from saline matter, and then it is carbonate of protoxide of iron, and ultimately becomes hydrated sesqui-oxide.

By Baron BRAMWELL: No part should be anhydrous, if dried at a proper temperature. The *Pharmacopœia* says it must be dried at a gentle heat, which it describes to be at 90° or 100° Fahrenheit.

By the ATTORNEY-GENERAL: There are about twenty-two parts of carbonic acid for every twenty-eight parts of metallic iron originally acted upon. If prepared from a solution which had been boiled, and from which all atmospheric air had been driven, and you were careful to maintain certain matters in the liquor which would not allow the oxygen to reach the carbonate, you might keep it any length of time.

By Mr. BOVILL: We have sold this article at Apothecaries' Hall ever since the *Pharmacopœia* of 1809. We cannot prepare it in a dry state, as an article of commerce, otherwise than as an oxide of iron. The moment it becomes dry it oxidizes.

This completed the evidence for the defence.

The ATTORNEY-GENERAL proposed to recall the plaintiff, but Mr. BOVILL objected. The ATTORNEY-GENERAL said his object was to call him to a specific contradiction, which he could not do until the evidence for the defence disclosed the necessity.

Baron BRAMWELL ruled that it might be done, and

Mr. *F. C. Hills* was recalled, and examined by the ATTORNEY-GENERAL.

I left London on the 4th of August, 1849, for Scotland. That was four days before Laming's experiments commenced at the Chartered works, and I was not there again more than once during the remainder of that year. Mrs. Hills went with me to Scotland, and we did not return until September. I went to the works about the middle of September, and was there only for about half an hour on that occasion. I deny in the most emphatic manner that Evans then told me a word, or gave me a hint of any sort that he was using oxide of iron. I was at the works during a great storm that year; that was on the 26th of July. The yard was flooded with water, and I nearly fell into a well. On the occasion of the arbitration before Mr. Rotch, Mr. Evans said it was on that day he told me he was trying something of Laming's. I was never on those premises on any other occasion when there was a great storm.

By Mr. BOVILL: I think Evans told me something about Laming's process for using chloride of calcium absorbed in sawdust. [Witness was interrogated at some length as to where he was on several days during the month of August, 1849, but no fresh fact was elicited.] I did call on Mr. King in Liverpool a short time ago. He told me he was distilling off the sulphur I did not say to him that if he had been burning off the sulphur I might as well give up my patent.

Mrs. *Anne Heding Hills*, examined by the ATTORNEY-GENERAL.

I am the wife of the plaintiff. I accompanied him in 1849 on a tour in Scotland. We left London on the 4th of August, and did not return until the end of the month; I am not quite certain as to the day.

Mr. *Thomas Hills* was recalled, and corroborated his brother's testimony as to his leaving London for Scotland on the 4th of August, 1849.

Mr. *Wonfor* recalled, and examined by the ATTORNEY-GENERAL.

I was present at the arbitration before Mr. Rotch in May, 1851. Mr. Evans was examined, and stated that he told one of the Mr. Hills about the renovation of the oxide of iron, but could not say which.

By Mr. BOVILL: I think notes were taken by Mr. Rotch himself at the time. I took some notes myself, as to what Mr. Laming had been using. [Book handed in, which contained memorandum made by witness on the occasion, "Told Mr. Hills of experiment."] I mentioned this to Mr. Hills on the previous occasion, but I think I only told the solicitor yesterday.

By the ATTORNEY-GENERAL: This is a letter which I wrote to plaintiff as early as the 10th of February this year, in answer to one in which he asked me whether I remembered anything in reference to the model which has been produced, and as to the position of the small purifier at the Westminster Gas-Works. I am not sure whether it contained any special remark as to what took place between Hills and Evans. In the reply, I say—"I remember well the arbitration before Rotch, and recollect perfectly Evans saying he told one of the Mr. Hills what he was doing, but did not know which. I have heard him tell Owen the same thing, &c." That is strictly correct and entirely true. It was on the day of the thunder-storm.

Baron BRAMWELL: As I understand it, the questions which I proposed to leave to the jury are two—first, Is the invention new? and, second, Is the plaintiff the inventor? These two questions branch out into others, as—Is it new as a whole? Is it new in that part which claims the purification of gas by hydrated oxide of iron? Is it true in that part which claims the process of renovation? Is he the inventor of it as a whole? Did he learn it from any one else?—for it is quite clear, if he is not the inventor of it as a whole, his patent fails—that is, if any part of it is not his invention, and yet is separately claimed, then he is not the inventor.

Mr. BOVILL then proceeded to sum up the evidence for the defendants. He said he would endeavour, as far as lay in his power, to present to the jury, in as condensed a form as possible, the observations which occurred to his own mind upon the questions which the learned judge proposed to leave for their consideration. No doubt, upon the evidence, the matter as it now stood involved, in one part at least, a rather serious inquiry; but it would not be necessary for the determination of the case, that they should absolutely decide which of the two parties was actually speaking the truth, because the matter might be determined independently of that part of the inquiry, viz., in which Evans and Hills were in direct opposition. The jury were now tolerably well acquainted with the nature of the claim which was put forward by the plaintiff as his invention, and which, he said, he had discovered before the month of November, 1849. The invention which he claimed was composed of two separate matters—each distinctly claimed and put forward—the one being the use of the hydrated oxide of iron for the purpose of purifying gas from sulphuretted hydrogen, the other for renewing the material after having been so used. His lordship, for reasons which were well understood at the bar, desired also that the case should be presented to the jury in another form, and that they should be asked to decide, not only whether each part of the plaintiff's claim was new, but whether, if both were old, the combination was new. He (Mr. Bovill) proposed to deal, in the first place, with the two separate claims. The question which they had to consider was—whether the use of hydrated oxide of iron was new in November, 1849; new in this sense, not merely whether it had been used before, but whether it had been known before and stated upon paper, which was actually sufficient for the purpose of preventing another person from obtaining a patent for it. For, though a thing might never have been previously used, yet if a patent were taken out, and a specification taken out for its use, it became a public matter; or if the fact were stated in a book it became a public matter, and equally as in the other case, a person would be prevented from obtaining a patent for it. Now, as regarded this particular matter, it was simply the use of hydrated oxide of iron for the purpose of the purification of gas; but Mr. Hills did not claim it as had been put forward by the Attorney-General, in the course of his cross-examination of witnesses, as a separate and distinct matter to be used alone for this purpose: but Mr. Hills claimed to have the exclusive use, and to have been the inventor of the use of hydrated oxide of iron, either alone or combined with any of the various sulphates or muriates mentioned in his patent, or mixed with any other purifying matters heretofore in use. Therefore, his learned friend could not confine the claim of the plaintiff now by simply treating the patent as a patent for the oxide itself. Mr. Hills claimed also to use it, not only in connexion with any other purifying material, but either with or without sawdust, breeze, or other porous material; and, therefore, he had spread his net in the widest possible form, so as to include everything. With the explanations which the jury had received, he thought there would be no difficulty in their comprehending in what the purification of coal gas consisted. There were two deleterious compounds from which the gas as produced had to be relieved—the one was ammonia, the other sulphuretted hydrogen; there were various chemical agents which were useful for depriving the gas of these two compounds, and they had heard a description of the material which was applicable to each. That being the state of things, he remarked that it was known to the world acquainted with those subjects generally, was published by Berzelius, and was familiar to chemists, that hydrated oxide of iron would take up sulphuretted hydrogen. To chemists, who were acquainted with that fact, and who were devoting their attention to the purification of coal gas, it would seem that it would not require any great stretch of the imagination to apply their knowledge to the removal of that impurity by this means. It was known that hydrated oxides of iron would do it, and it was known to some—not all—that anhydrous would also answer the purpose. Mr. Croll, who had been, perhaps, one of the most energetic discoverers in science connected with gas purification, so early as the year 1840, (being at that time only the superintendent of a gas-work, but having since advanced himself almost to the head of his profession,) made, not the discovery, but the application of a known chemical fact,—viz., the absorption of sulphuretted hydrogen by oxide of iron, distinctly to the purification of gas. The process which he adopted was one which distinctly produced a hydrated oxide, the material which he used being muriate of iron and lime. The whole evidence, from the beginning to the end of the case, showed that the oxide so produced was a hydrated one. Mr. Croll, not being a scientific chemist at that time, nor so well acquainted as he now was with the principles of chemistry, stated that he was not then aware of the difference between a hydrated and an anhydrous oxide, though he was aware that oxides might be usefully and beneficially applied to the purification of gas—a fact which he, in that year, published to the world. Now, it was clear that if that was the case, and Mr. Croll filed in a public office a statement to that effect, that alone would prevent any other person afterwards coming forward to claim oxides of iron for the same purpose. No one could doubt, from the evidence which had been given, that oxides of iron as mentioned by Croll, included both hydrated and anhydrous; and also that any person with ordinary chemical knowledge—and this was a fact which was elicited from their own witness, Dr. Miller—having that specification placed in his hands, would have used a hydrated oxide, because of its known property for absorbing sulphuretted hydrogen. In addition to this, all the witnesses concurred that, but for the passage relating to a red heat, they should assume that the specification pointed directly to the hydrated oxide of iron. But, although Croll did not use the word "hydrated," it clearly could not be affirmed by the Attorney-General that his specification did not include hydrated, because persons who were conversant with these matters knew that "oxides" was a general term in chemistry, and that it comprehended both descriptions; and if this was admitted, then it followed that the plaintiff had been anticipated in this part of his claim. But the matter did not rest here. The witnesses who had been examined, proved that there was a direct indication by Croll that he proposed to use the black oxide of manganese, and that when he first began the process he would certainly have an oxide which was hydrated. Nor was this all; for they had now the very important testimony of Mr. Croll himself upon the subject, who had given them a distinct intimation that, in preparing his oxide of iron, he used muriate of iron and lime; so that it was evident, even if the subsequent operations converted it into an anhydrous oxide, it must have been hydrated in the first instance. The next step they had to take in this inquiry did not depend upon the specification of Mr. Croll, but upon the question what did Mr. Croll do, openly and publicly, at the gas-works in Brick Lane. As he (Mr. Bovill) had already said, supposing a man had not obtained a patent for a certain process, yet, if he had published it to the world in a book, or elsewhere, he prevents another person securing it by a patent. And it was equally so if, not having a patent, he had openly used a particular matter in the course of his operations. Now it appeared that, in 1840, Mr. Croll did purify thousands upon thousands of feet of gas, week by week, with the oxide of iron. This Mr. Croll himself had sworn to, and there had been no attempt to impeach his testimony. The fact was admitted, it could not be disputed, that, at the Chartered Gas-Works in Brick Lane, Mr. Croll did, nine years before the plaintiff's patent was taken out, purify the gas there manufactured by an oxide of iron which he had prepared by decomposing muriate of iron with lime; and Mr. Croll was perfectly aware that the material which he so obtained and used was an oxide of iron. But there was something proved more than this. Mr. Croll went on to detail to them that, although in the first place he thought it better to roast the sulphuret of iron after he had gone through the process of purification, so as to get rid of the sulphur which it contained, yet that afterwards he did openly, at the Brick Lane Works, adopt the plan of not heating it to redness, but simply placing the material, after it had been withdrawn from the purifiers, upon the top of the retort-house, and there allow the sulphur to pass off at a temperature of from about 400° to 600°. Therefore they had the fact that time after time was this material, which was prepared from muriate of iron and lime, used over and over again, that it was a hydrated oxide in the first instance; that, roasted on the top of the retort ovens, it still remained a hydrate; and that it was efficacious in every instance for the purification of gas. Was there any doubt of these facts? Did his learned friend mean to suggest that he questioned the accuracy of these statements? He (the Attorney-General) did not attempt to impeach Mr. Croll's facts, but, with extreme ingenuity, he asked Mr. Croll, "Did you not read a paper before the Association of Civil Engineers, in which you state that lime will for the future be the method employed for purifying gas?" In that paper Mr. Croll was discussing the commercial advantages of one system of purifying over another; it was a question of pounds, shillings, and pence; and he stated that he was of opinion, looking at the agricultural and other purposes to which the products might be applied, that the use of lime, wherever you could get rid of the deleterious matters, was the least expensive, because it yielded the largest amount of product. The learned

counsel having read an extract from the paper read by Mr. Croll on that occasion, said it appeared to him that the writer was dealing with the subject, not only with reference to the question of commercial advantage, but actually instituting a comparison between the dry lime and the wet lime process in regard to the purification of gas from ammonia. There was not a word about sulphuretted hydrogen throughout the whole of the passage, and he hoped the jury would read the paper for themselves, and see how unfair a use had been made of this passage by those who had instructed his learned friend the Attorney-General. But further, the matter was completely set at rest by the learned judge asking Mr. Croll, "Was your invention practically a failure?" "No," said Mr. Croll, "I granted many licences; but as I found a market for my lime, I used it in preference to the oxide of iron, and it is only now because I cannot get rid of my gas liquor I cannot now use that which I know to be a good purifier." Whether his patent succeeded or not, whether it was of the least value or not, was not, after all, the question here; the question was, did he tell the world you may use oxide of iron, and did he himself use it? If he did, then no other person, whether the process failed or succeeded, could go nine years afterwards and say, I claim a patent for its use. So that whether the jury took it on the patent or on the use, the thing which he used was hydrated oxide of iron, and that which he claimed included hydrated oxide of iron. He would not trouble them by going through passage by passage of Croll's specification, but he would read to them one or two passages in which it distinctly appeared that he meant it to be understood that he used the hydrated oxide of iron to purify gas from sulphuretted hydrogen. The learned counsel having quoted and commented upon the passages disclosing the third part of the improvements claimed by Croll, said he did not understand how the Attorney-General proposed to answer these points, and he challenged him to disprove the assertion that Croll did not include the hydrated oxide of iron in his patent, and that he did not in practice adopt it; and such being the case, he contended the plaintiff was altogether prevented from putting in a claim to the use of that material. They now came to the next part of the case, which bore upon the patent obtained by Laming. Between that patent of Croll and this one there was an interval of seven years, and Mr. Laming when he came to deal with the question of oxides found, to his dismay, that there was a patent already in existence for their application. He, therefore, could not claim oxides; but finding out that the material which produced oxide was useful in the purification of gas, he adopts the process which Mr. Hills afterwards adopted, trying under another name, and calling the result a carbonate. Instead of saying I use a mixture which, in reality, is an oxide of iron, he says, I use and claim the application of a mixture which includes chloride of calcium, and which is prepared by decomposing muriate of iron by means of lime or chalk, when the latter will suffice. He could not claim oxides because Mr. Croll already had a patent for them, and accordingly it would be found at page 5, line 21, of his specification, after having described the mode of producing the chloride of calcium, he said: "I do not claim either of these processes for making a mixture of chloride of calcium and a metallic oxide or corbonate, but I do claim the application of mixtures so made to the purification of coal gas." So that it would be seen that Mr. Croll not having claimed a mixture, Mr. Laming came forward, and, finding he could not claim the oxides, determined to call his preparation chloride of calcium, and to claim it as a mixture.

Baron BRAMWELL intimated an opinion that it was not correct that Laming claimed a mixture.

Mr. BOVILL said his lordship would see that he was mistaken by-and-bye. The first part of Laming's claim was on page 4, and there he described the use of chloride of calcium, which he said was to be prepared with muriate of iron and lime.

Baron BRAMWELL: And he said—"In making it I produce an oxide, but do not suppose I claim it."

Mr. BOVILL said in this his first part he was speaking undoubtedly of chloride of calcium, and had not stated that it contained an oxide; but it was quite clear that the chloride of calcium, which he proposed to use, was one which he afterwards said might be prepared in a convenient manner, and in a way which would contain the oxide. Here he said: "I do not claim the use of that re-agent in a dry state, nor when it is in a fluid condition. Both these ways are attended with inconvenience: in the one case, fluids cause objectionable pressure on the retorts, and in the other case dry chloride of calcium desiccates the gas, and thereby causes it to deposit napthaline. I avoid both those evils by causing a strong solution of the chloride in water to be absorbed into dry sawdust, or other convenient matter, in such proportion as to confer upon the mass the form of a wet and granulated powder." The reason why he (Mr. Bovill) had read this was, that the plaintiff had produced before them a material which they alleged was a specimen of what was produced by Laming's process; and it was said, that in such a state the material would not purify the gas effectually. Why, the truth was, Mr. Laming, at the outset, clearly spoke of powdered chloride mixed with sawdust, &c., and, therefore, not in a state of solution. When he (Mr. Bovill) asked the question, "Has this material, which is produced, ever been dry?" Mr. Campbell told them that it never had been so; that it was clearly not prepared as Mr. Laming directed. In a future part of his specification, Mr. Laming said: "Chloride of calcium is both abundant and cheap, but under certain circumstances it may be desirable to make it, for the purposes of gas purification, by decomposing muriate of iron by means of lime or of chalk, when the latter will suffice." Now, they had heard a great deal from some of the witnesses, that chalk would not answer unless you employ heat; but that was disproved by Mr. Laming, who produced two specimens which he had made without heat. Dr. Odling also stated the same thing, and his evidence was confirmed by that of three or four other gentlemen. Laming then went on to say—"In such cases the oxides or carbonates that result are useful for the said purification and need not be removed." There had been a deal of discussion as to what carbonates were. The evidence as it stood distinctly proved that, in the language of the laboratory, a carbonate meant a strict carbonate, but that, in the language of the world, of chemists and druggists, and of all persons except those engaged in laboratory experiments, what was understood by carbonate of iron was not what was called a strict carbonate, but was the stuff supplied by Apothecaries' Hall and the best chemists in London under the name of carbonate of iron. Mr. Warrington had told them that druggists and persons of twenty years' standing in the profession still called it by the name under which it was known when they were young, and that if you asked for carbonate of iron, you got the material a specimen of which had been produced here, and which was a hydrated oxide of iron. At first sight, it appeared strange to say that a carbonate was an oxide, but the fact was, they could not get a true carbonate in a dry state, because the moment they began so to prepare it, the action of the air in the process of drying deprived it of its carbonic acid; so that though it might be said that a carbonate must be a carbonate, and an oxide cannot be a carbonate, yet, when they had to deal with a thing so volatile that it passed from one state to another in the very act of procuring it, we might well talk of it in a general way as an "oxide or carbonate." And again, they must bear this in mind, that the witnesses proved that there were some carbonates here described which were not strict carbonates, and oxides which were not strict oxides; and so again in the process described by Mr. Hills it was shown that his oxides were not strict oxides but carbonates. But the substance, call it by what name they pleased, was the muriate of iron decomposed with lime; and the use of the case to which he had referred was to show, that if they were dealing with a thing having a common name, that common name should be used in the specification.

Baron BRAMWELL: Supposing, instead of saying the oxides or carbonates, he had said, "the things which result are useful for the said purification and need not be removed?"

Mr. BOVILL said that would have been sufficient.

Baron BRAMWELL: And has he not said so?

Mr. BOVILL: So I say.

Baron BRAMWELL: Then why do you labour this point which is so clear? Really my heart is hardened against you. You admit that if he had said, "the things which result are useful, &c." would do—what then does it matter whether he has called them by right names or wrong?

Mr. BOVILL said his reason was that the Attorney-General had so urged the point.

Baron BRAMWELL: He says the thing which really does result is a carbonate and not an oxide.

Mr. BOVILL: Gentlemen, it is very easy for them now to change their ground and say that is not the name. What is the meaning of all this evidence?

Baron BRAMWELL: It is all nonsense.

Mr. BOVILL believed it was all nonsense, and perhaps that was the best thing that could be said of it, but if he had not answered it, the jury would perhaps have heard more of it than he was inclined to think they now would. Mr. Laming then went on say—"the oxides or carbonates which result are useful for the said purification and need not be removed." He had not said for what purpose either of these mixtures down to this point were to be applied, whether for getting rid of the ammonia or the sulphuretted hydrogen, but simply that they were useful for the purpose of purification. He then proceeded—"Another part of my invention consists in the use of the carbonate of iron for the purification of coal gas; for which purpose I damp and dispose it, mixed or unmixed with sawdust, or other matter, in the course of the gas, as is practised with hydrate of lime; or I mix it with the muriate matters, which I have claimed as my invention, or with other purifying matters hitherto in use for a similar purpose in a state of mechanical division"—the very words which were found in Hills' specification afterwards; and then he went on to describe how he obtained those carbonates in an economical manner. Referring back to an earlier part of his specification, it would be found that having claimed the use of the carbonates, he said—"for which purpose I damp it, &c." It was proved by all the witnesses that they could not get the carbonate in a dry state without its becoming an oxide, and it was clear from this passage that Laming distinctly pointed out the use of a dry substance which he afterwards damped, a process which Mr. Hills subsequently claimed. The next thing to which he referred was one to which in the early part of the case but little attention was directed. As far as they had gone, the Attorney-General contended that what was stated by Laming was a pure carbonate, but he must take that with the fact that, whatever it was, it was in a dry state; and it had been proved that when dry it became a hydrated oxide. But if they used the process which he mentioned above, the muriate of iron with lime or chalk, it did not produce a carbonate, but an oxide; and in the early part, therefore, he had stated the production of iron, and in the latter part the production of a carbonate. Then, again, he said: "Another part of my invention consists in increasing the purifying powers of the aforesaid preparation of chloride of calcium, and also of the aforesaid metallic salts absorbed in solution into sawdust, by adding thereto oxide of iron obtained in a proper state from any economical source. I do not claim the exclusive use of any metallic oxide for purifying coal gas, &c." Here he clearly drew a distinction between oxides and carbonates, showing that he knew the difference between the two. Well, then, here was Mr. Croll in 1840 telling the world that oxides of iron would purify gas, and Mr. Laming in 1847 saying it might be done by muriate of iron decomposed by lime, the power of which might be increased by adding thereto oxide of iron. If they went to buy oxide of iron to add to this preparation, they would get this red material—the hydrated oxide—and thus there was a distinct claim to the use of that which Hills afterwards patented up to this point, as he had said there was not a syllable to show for what purpose the material was to be employed; but now he stated, "I do not claim the exclusive use of any metallic oxide for purifying coal gas, but what I do claim is, the combination for that purpose of the oxide of iron with the other purifying matters above indicated, whereby the gas may be perfectly purified from its ammonia and its hydro-sulphuric acid, without requiring a succession of purifying vessels." Now one of the first things which Hills mentioned in his specification was hydrated or precipitated oxides, which he said might be conveniently prepared "by decomposing sulphate or muriate of iron with hyrdro-sulphuret of ammonia, or with lime, magnesia, potash, or soda." Why, here was the very process by which Laming had said you may produce a chloride of calcium, and as it had been proved by Dr. Miller—whether you wished to produce either the one or the other, you used the same materials, in the same proportions, and you also obtained the same results. The two things were identical, not only as regarded substance and process, but also effect in the purification of gas. His learned friend pointed out that Hills added to this description, "they may then be absorbed, &c.;" no doubt "they may be;" but it did not say they must be; and indeed so far was the plaintiff from saying they must be, that on page 7, line 13 of his specification, he said they might be used "either by themselves, or, which is much better, made into a more porous material by being absorbed into or mixed with sawdust or breeze, or peat charcoal, in coarse powder or other porous or absorbent material, so as to be readily permeable by the gas, and either used alone or mixed with sulphate of lime, &c. &c." The passage nowhere said that this would not be a hydrated oxide unless so mixed, but treated it only as a purifying material prepared by decomposing muriate of iron with lime, which he said might afterwards be mixed with sawdust, &c., and might afterwards be exposed to the air. Talking about exposure to the air being a necessary part of the process, why Mr. Laming told them that they might use his material in a dry or damp state; to make it dry it must have been exposed to the air; and then he said, "You may mix it with sawdust, &c." The next thing was that Mr. Hills said that the precipitated or hydrated oxide of iron might be conveniently prepared "by decomposing sulphate or muriate of iron with hydro-sulphuret of ammonia;" and Laming had also stated the same—*i. e.*, he had said it might be done by means of ammoniacal or gas liquor obtained in making coal gas, which the witnesses stated was the only practicable mode of obtaining hydro-sulphuret of am-

monia. Here, again, therefore, was an identity of substance, and of the means of producing it; and for the very same purpose producing the very same results. And yet his learned friend said that there had been no anticipation of Hills' invention in the specification of Laming. It was an observation made upon this patent of Laming, that when he was specifying in 1847, he treated the oxides as old things. He did not attempt to say, "I claim the oxides as applied to gas;" all that he attempted to claim was, a mixture in a particular mode, Mr. Croll having anticipated him in reference to the oxides themselves. After referring to the evidence at some length, to show the identity of the processes adopted by Laming and Hills, the learned counsel proceeded to say, that the next point with which he had to deal was the statement that Hills was the discoverer of this matter in 1848. It would be remembered that, in his former address, he had referred to the plaintiff having taken out a patent in the month of October in that year, which patent he specified in the month of April, 1849. He would now shortly state to them what it was the plaintiff claimed by that specification. Having read portions of the specification and claims, he said the reason he called attention to the matter was, to show that he there described a mode of absorbing gases into porous bodies, and of removing them by the draught of a chimney or by an exhausting machine; and he thought the jury would agree with him, that if, as he said, he had perfected the invention which he now claimed at the end of 1848, he would certainly have included it in this specification filed in April, 1849. He then referred to the deposit-paper and the specification of the patent now under consideration, pointing out the differences which they exhibited in regard to the plaintiff's claim. He said the thing was utterly incredible, and he believed his learned friend the Attorney-General, with all his ingenuity, would have great difficulty in persuading the jury that a person who had discovered the process of purifying gas by hydrated oxide of iron, or the renovation of the exhausted material, would have used such language in describing, especially under the circumstances, as Mr. Hills had done in his deposit-paper—namely, the absorption of sulphuretted hydrogen and other gases into porous bodies, and their removal by heat, or taking off the atmospheric pressure. Mr. Hills was no fool in chemistry, he understood the use of terms perfectly well, and it had been proved by witnesses that day that the taking off of atmospheric pressure in an air-pump even would not remove the gases or other matters absorbed into the hydrated oxide of iron. Therefore it was not true in point of fact; and the only suggestion which could make the paragraph in the deposit-paper intelligible, was that the plaintiff's mind was running upon the subject for which his patent in 1848 had been taken out. It appeared to him (Mr. Bovill) that the truth was, the plaintiff, as Mr. Thompson had suggested, kept an open patent for improvements in the manufacture of gas, and was in the habit of handing in some general statement of this kind; and then, having defeated Mr. Laming and Mr. Evans in their attempt to get a patent for this invention, when he came to specify in the month of May following, he, for the first time, laid claim to be the inventor. Having dealt at large on these points, the learned counsel came to speak of the further claim to the process of renovation, and he started with the remark that the principle was well known long before the date of the plaintiff's patent, and was practised by Mr. Croll in 1840. Whether or not, however, it was admitted that Mr. Croll did it by the action of the air, it was quite certain, and they had distinct proof that Laming did in the month of February, 1849, at least eight months before the plaintiff took out his patent. No contradictory evidence had been offered on that point, while the statements in support of it had been confirmed by the paper handed in by Mr. Newton, produced before the Attorney-General on the 15th September, 1848, in which Laming stated that he claimed the "recovery of some of the purifying re-agents for repeated use. For this purpose I simply expose to the air the sulphuret of iron which results from the purification of illuminating gas by hydrated peroxide of iron. This exposure causes it to change back again, partly into a peroxide of iron and partly into a sulphate of iron." Here, then, was a statement of this renovating process, which Hills now claimed, proved to have been made before the Attorney-General fourteen months before the date of his patent. In addition to this, they had also a document filed in the records of France before this patent was taken out, in which it was said——

Baron BRAMWELL: Are these remarks for the purpose of showing that Laming knew of the property of the hydrated oxide and of its renovation?

Mr. BOVILL: Yes.

Baron BRAMWELL: I do not know whether the Attorney-General denies that.

The ATTORNEY-GENERAL: I think not.

Baron BRAMWELL: You admitted three days ago that he did not know some one had previously invented it, though some one previously had. It is one thing, therefore, to show that some one had invented it before, and another whether he knew of it. Perhaps the Attorney-General will tell you whether he meant to say that he had found it out in 1849.

The ATTORNEY-GENERAL: I have never suggested a doubt about it from the moment that the date of the paper appeared.

Mr. BOVILL said his learned friend did all he could to exclude that document, because he did not like to have the evidence. The learned counsel read portions of that paper, and then commented at some length on the evidence which had been offered by plaintiff's witnesses. The only other point, he said, to which it was necessary to call attention was the question whether the combination of the two processes was new. That, however, practically came to the same thing, if the jury believed what had been done by Laming. He submitted to their better judgment, that upon the facts which he had proved before them, and upon the patents and other documents which had been introduced, he had established the point that the plaintiff was not the inventor, and he left the case, on the part of the defendants, with confidence in their hands.

SATURDAY, AUG. 14.

Baron BRAMWELL (to Mr. Laming): What are the two things which result from the use of muriate of iron and ammoniacal liquor?

Mr. *Laming*: If the ammoniacal liquor is used without any previous preparation, there are two things which result from the decomposition—the one is a carbonate of iron, and the other a sulphuret of iron.

Baron BRAMWELL: Supposing you get rid of the sulphur first?

Mr. *Laming*: If you get rid of the sulphur first, which is one of the processes described in my specification, then you get carbonate of iron. The muriate of ammonia remains in solution in both cases.

Baron BRAMWELL: Could that be used for the purification of gas?

Mr. *Laming*: Yes, if the whole is mixed up with sawdust then you can.

Baron BRAMWELL: Some of your preparations when used together would absorb both ammonia and sulphuretted hydrogen?

Mr. *Laming*: This would not.

The ATTORNEY-GENERAL then proceeded to address the jury. After describing minutely the particulars of the plaintiff's claim, which he characterized as for a great and beneficial invention, that had been brought into extensive practical use and operation, he referred to the patents and experiments of Mr. Croll and Mr. Laming, which, he said, had never been substantially employed in any of the large gas-works of the metropolis—both, in fact, had fallen dead in the patent office, both were mere nullities. It appeared to him, he said, that this cause involved most important considerations. If a patentee was to be deprived of the benefit of a patent, and if the inhabitants of this country were to be deprived of one of the most beneficial inventions which could emanate from human genius—and they would be deprived of it, if juries did not continue the encouragement of patentees by supporting their rightful claims, so that they would be stimulated to devote their energy, genius, knowledge, and enterprise to improvements in the various departments of human activity—not only, he said, would patentees be deprived of encouragement, but the public would be deprived of some of the most beneficial inventions which could operate for the good of society; they would do all this if once the principle were admitted that, because something like, or perhaps even identical with, the subject of a patent had, years and years before, been made the subject of some partial, or apparently for the moment, even successful experiment, and afterwards had been disused, forgotten, and never submitted to the public, and from which the public never derived the least benefit—that therefore the patent so obtained was to be set aside, and the patentee told that his invention was not new. In the present instance, they were met not only by the patents of Croll and Laming, of which the world never would have heard but for the invention of Mr. Hills; but they were also told of the experiments of those gentlemen, from which, also, the world never derived any advantage, and which were never heard of until brought forward as proofs in the courts of law to support these attacks upon the patent of Mr. Hills. There had also been books quoted, and men of science called before them as witnesses, to tell them that the principles involved in this invention were known in the science of chemistry long before Mr. Hills filed his specification. The fact was that, notwithstanding new discoveries were from time to time being made in chemistry, and in nearly every other science, the great leading active governing principles in all these sciences had been known to learned men almost for centuries. Take the case of the steam-engine. Why, every element of human knowledge, every scientific, chemical, and mechanical principle involved, or in any way embraced or comprehended by the invention of Watt, was perfectly well known by men of science centuries before Watt was born; and if the work published by the Marquis of Worcester had been carefully, studiously, and minutely acted upon—if it had been taken to pieces, divided, separating the principles from their adjuncts, the materials from the mass, the steps and stages of the process from the great result—if this had all been done by some patient scientific man with the Marquis of Worcester's work in his hands, and subsequently the patent obtained by Watt for the steam-engine had been impeached as this patent had been impeached, and the cause had been tried and discussed for four days before the gentlemen he had the honour to address, he would undertake to say that identity, after identity in principle, in substance, in process, in result, would be discovered from beginning to end. Everybody knew, and had known for centuries and more, that flame would not penetrate gauze, before Sir Humphrey Davy invented his safety lamp; and would it have been right to have deprived him of the benefit of his invention, which had been the means of saving the lives of thousands, because it consisted in the application of a principle as well known as that oxygen and hydrogen would form water? So, also, might the same remark be applied to the application of the hot blast—one of the greatest, and at the same time one of the simplest inventions of modern times. Who did not know that hot air would smelt iron? When iron was smelted by blasts of cold air, a moment's reflection would tell any one that the air became heated in the furnace before it affected the metal; and yet the simple expedient subsequently adopted had never occurred to any one, any more than in the present instance. The simple process of spreading out a quantity of the exhausted oxide of iron and causing the air to pass it over would renew its energies. Everybody knew that hot air would smelt iron, and everybody knew that sulphuret of iron might be decomposed by oxygen. But the great merit of that beautiful invention, as simple as it was universally beneficial, so highly useful to the public in the most important of all our manufactures—the manufacture of iron—the staple native commodity of Great Britain—the merit of that invention was reserved for recent times; and he (the Attorney-General) was old enough to remember (and he was not sure that in those his early days he had not the assistance of the learned judge on the bench) that they were driven from court to court, not only in England but in Scotland, and at last were compelled to resort to that last court of appeal, the House of Lords, to establish the right of the patentee to that invention. These were considerations which he ventured to impress upon the jury as of the greatest value in forming a judgment on the case in hand; and he ventured to hope that they would not disregard them in pursuing their investigation. The learned counsel then went into a minute and elaborate review and criticism of the whole of the evidence, his address extending over a period of four hours. He concluded by thanking the jury for the patience with which they had gone through the proceedings of one of the longest, and, except to the parties concerned, most uninteresting of trials; and in the complete conviction that full justice would be done to his client, he left the case in their hands.

Baron BRAMWELL (to Mr. Thompson): I need not caution you to answer me carefully. You say that chloride of calcium and muriate of lime are the same things, and will purify gas from carbonate of ammonia?

Mr. *Thompson*: Yes.

Baron BRAMWELL: I believe if you were to precipitate with sulphate of iron, instead of muriate of iron, and lime, you would get sulphate of lime?

Mr. *Thompson*: Yes.

Baron BRAMWELL: Will that purify gas?

Mr. *Thompson*: Exactly in the same way.

Baron BRAMWELL: Are they equally efficacious in connexion with carbonate or oxide of iron?

Mr. *Thompson*: Exactly.

Baron BRAMWELL: Which is the cheaper or more convenient of the two commodities?

Mr. *Thompson*: Generally speaking, the sulphate, because copperas is a largely-manufactured salt, and consequently, I should think, the cheapest; but it would depend very much upon the state of the market at the moment. I speak as to the original composition.

Baron BRAMWELL: Yes. Supposing a man desirous of making one or other of the mechanical mixtures of sulphate of lime and carbonate or oxide of iron, or oxide of iron and chloride of calcium, can you undertake to say which would be the more practicable and most cheaply prepared?

Mr. *Thompson*: I think, generally speaking, a sulphate, but at the same time there are exceptional cases; as, for example, in the neighbourhood of

Newcastle, where muriatic acid is manufactured by the soda-makers, and in that case it is the mere waste material.

Baron BRAMWELL (to Mr. Owen): Be good enough to tell us the component parts of the mixture which you sell to the gas companies now.

Mr. *Owen:* Sulphate of iron, lime, and sawdust, mixed together.

Baron BRAMWELL: Do you never use muriate?

Mr. *Owen:* Never.

Baron BRAMWELL: Why do you use sulphate only?

Mr. *Owen:* Because Laming and Co. used it.

Baron BRAMWELL: Do you know any other practical reason for it?

Mr. *Owen:* Because I believe it put an end to the dispute between Laming and Hills.

Baron BRAMWELL: You use it because you believe it is in his patent?

Mr. *Owen:* Yes.

Baron BRAMWELL: There is no practical reason?

Mr. *Owen:* Yes; chloride of calcium being mixed with it, and being deliquescent, it prevents its action; and I have heard Mr. Evans say so on behalf of the company.

Baron BRAMWELL then proceeded to sum up the case. He commenced by saying, that with the exception of the remarks which he should feel it necessary to offer, and the verdict which the jury would afterwards be called on to deliver, they had now got to the end of this lengthened investigation; and from what he had seen of it, he was by no means sure that the jury would not agree with him that a more inconvenient tribunal could not have been provided for the consideration of a case of that description. It was impossible not to feel that they had, as it were, to learn the very terms of a science, a familiar acquaintance with which was almost indispensable to enable them to decide in a manner satisfactory to themselves. He was not quite sure that, even after all the discussion which this case had undergone, they knew sufficient of the chemical bearing to come to a satisfactory conclusion upon it. However, there was no other tribunal, and therefore the parties were compelled to have recourse to them to settle the matter between them. But of one thing he was absolutely certain, and that was, that this case ought never to have been tried at the assizes. It was a matter of obvious inconvenience that the parties in a metropolitan dispute should be brought from their homes in the metropolis, to be subjected to all the inconveniences of an assize town, unless a pressing reason could be assigned; and in the present case it was certain the matter would not end with the decision arrived at here. For his own part, he was firmly resolved that, having the opportunity, he would take care to prevent such an abuse again. However, he must say that he fully concurred with the learned counsel on both sides that the parties to this suit could not by possibility complain that there had been any want of diligent and patient attention on the part of the jury. The learned baron then proceeded:—Now, gentlemen, I propose to leave to you two questions—the one is, Is the plaintiff's invention a new one? and the other is, Is he the discoverer of it? It might seem at first sight that these two questions were identical, because it might be supposed that if he was the discoverer of it, it must be a new matter; or, on the other hand, if it is a new matter, he must be the discoverer of it. But that is not so, as you will see from the explanation which I will give you. You know, if a person had invented or found out a secret which was the subject-matter of a patent, and had kept it to himself, or communicated it only to one or two, and not made it a matter of public knowledge—in that case, if any one else were to patent the invention, it would be new; that is to say, it would be new in this sense—that the prior invention had not been made public. Of course every invention must be kept secret before it is patented, but still, if the inventor were to tell it to some other person, who was to go and patent it, though new to the discoverer, yet the person so obtaining the patent would not be the discoverer. That, I think, is quite enough to enable you to discern the difference between the two questions. And now, gentlemen, these questions, in my mind, branch out into three divisions; and I am sure I need not apologize to you, nor to any one else, for asking you to decide as much as you can be asked to decide, because I am persuaded that the learned counsel on both sides know that questions of more complications never arise than those involved in patent cases, and, of all patent cases, those called chemical patents. Whatever opinion I may have upon this matter, and whatever opinion you may have, yet—inasmuch as whatever I do here is subject to appeal, and other learned judges might take a different view to what I have done, either because I happen to be wrong, or they, in reviewing what I have done, might reverse my opinion, and say, instead of deciding a practical matter, I ought to have asked the jury upon it—it is for the benefit of the parties in the case that I should take your opinion upon as many questions as I can in order that I may apply the law; and if my interpretation of the law is wrong, that I may be set right without subjecting the parties to the expense and trouble of a fresh trial, and another twelve gentlemen to go through the same process which you have undergone. I think, therefore, you will agree with me that I am right in asking your opinion upon as many matters as I possibly can. I have said that the two questions which I intend to submit to you branch out into three others, and I will just now briefly tell you what they are. The plaintiff says, I have invented an improvement in the manufacture of gas, which consists in this: that I pass the gas as it comes from the coal, or after having been purified from the ammonia, through hydrated oxide of iron to get rid of the sulphuretted hydrogen. But that alone will not do, because it would not pay commercially; and so, after the purification, I renovate the iron by exposing it to the air. It is obvious, therefore, that his invention means three different things. You may say he claims to purify gas by hydrated oxide of iron; you may say he claims to have invented the renovation of the oxide so used; and you may say that, in the third place, he claims the combined process. I shall ask you, therefore, to tell me whether you find the first new, the second new, and the whole new, or whether you find either, or any, or the whole. In the same way he may be said to claim to be the inventor of the first thing, the second thing, or the whole; and I shall ask you, in like way, to tell me whether he invented the process of purifying gas by hydrated oxide of iron, whether he invented the process of renovation, and whether he invented the compound. And, gentlemen, I am afraid I have not done with you yet, because it may be a question whether I ought to construe Croll's specification; and if you find that any one of these matters is not new, or that the whole is not new, I shall ask you to tell me whether you find that to be so upon the facts in evidence, independently of the specifications, or whether those specifications induced you come to that opinion. So that I shall ask you to answer me these six questions; and if you answer one or more unfavourably to the plaintiff, I shall ask you to tell me whether you have done so on consideration of the specifications, or upon what other ground. Now, these being the questions which I propose to leave to you, I will now—and you must forgive me for going over ground which the learned counsel have already gone over, inasmuch as we may not all be in the same mental condition upon that point—I say you must forgive me if I repeat some of the things already stated to you. Now, first, let me tell you what the plaintiff's patent is more in detail. He says: I claim the purification of gas by means of the hydrated oxide of iron, and the renovation of that material afterwards. It is desirable you should bear in mind distinctly that he does not claim the preparation of hydrated oxide of iron. You will find that, in point of law and good sense, if every word that he says about the preparation of the oxide of iron were struck out, his patent would not be affected thereby. For he says—"My invention is the *use* of the hydrated oxide of iron;" and then he says, by the way, "I will tell you how you may prepare it." But he does not tell you that that preparation is his invention; and his patent would be identically the same, if that much-discussed clause at page 14, beginning, "Hydrated or precipitated oxides of iron may be conveniently prepared, &c.," were struck out altogether. I do not know that you will find it material when I call your attention to it, but you must bear in mind that it is no part of his claim, nor, for legal purposes, any part of his specification. Now, gentlemen, his first claim is as you know, if it stood by itself without the clauses for the renovation, simply a claim for the purification of gas from sulphuretted hydrogen by passing it through the hydrated oxide of iron, either with or without certain other substances mechanically mixed with that oxide. That is his first claim, and it is for the purification of gas. If his patent had stopped there, there would be no reason to suppose but what he contemplated taking a charge of the purifying material, passing the gas through it, and then throwing it away. Well, now, it is said that that is not new; and it is said not to be new, because Mr. Croll had previously patented a similar invention, and because also, independently of his patent, Mr. Croll had previously practised a similar invention. Of course I need not tell you that if a man were to state in his specification, or in any way were to publish otherwise, that he had made such and such an invention, it would preclude the possibility of any one else inventing it *de novo*, but it would also preclude the possibility of another new invention upon that subject. If, therefore, you should be of opinion that either Mr. Croll specified in his patent the same thing as the plaintiff here describes, or if you should be of opinion that Mr. Croll practised the same thing which the plaintiff here specifies, then the plaintiff's specification is of a matter in that part which is not new. But now let me tell you what the law is upon that matter. When I say the same, you must not suppose it need be identically the same; because if there is a difference—which I suppose one might call a difference in form more than in reality, and which in mechanical language is called the substitution of a mechanical equivalent—it would be substantially the same thing. So you must understand it must not be a colourable variance; there must not be a difference merely in some of its details, while substantially it is the same process. Now, I ought to make another qualification in reference to Croll's practice of this invention; and it is this. If a man tried this process by way of experiment, and not in a substantial manner, that is not such a practice as would be a publication of the invention, and a person subsequently finding it out would not be prevented taking a patent upon it. Having said that to you, let us examine Croll's patent, and see what Croll did, and whether either the specification or the practice of Croll was the same as that which the plaintiff claims under this part of his specification, which clearly is the use of the hydrated oxide of iron. Now, Mr. Croll seems to have specified pretty much in accordance with the then state of his mind. Mr. Croll further told you very fairly, "I knew there were such things as anhydrous and hydrated oxides. I had a notion that one or both of those oxides would effect the purification of gas from sulphuretted hydrogen, but I did not know which, and I did not know which I was operating upon;" and he tells you fairly enough also, "I did not know what became of the sulphur." Still, he did know that some oxides would do it, and he had, in point of fact, practised it accordingly. That being the state of his mind, we expect to find the same thing in his specification, and so we do. He says: "The third part of my improvements in the manufacturing of coal gas consists in the application of the black oxide of manganese to remove or free coal gas of sulphuretted hydrogen, which is accomplished in the following manner." Then he describes what he does and how he does it; and then he says he passes the gas through and it loses its sulphuretted hydrogen; and so far, therefore, that would be consistent with the use of a hydrated oxide or of an anhydrous one—except this, indeed, that it appears to have been a prevalent opinion at that time, that anhydrous oxides would not purify. It seems now (I will not weary you by reading the evidence upon the subject) that anhydrous oxides will purify. The difference between them and the hydrated ones appears to consist in the mode of their taking up the sulphur; and one would rather infer that if you unhydrate a hydrated oxide, so as to make it anhydrous, that oxide will still purify gas; whereas if you get it by some other means, it will not purify. Now, with the knowledge we have acquired, I should say that if it stopped here, that rather indicates the use of either oxide, because we now know that either the hydrated or the anhydrous will purify. But, at the time when Mr. Croll invented his process, and, indeed, when the plaintiff specified, it appears that the state of chemical knowledge was such that people would refer it to hydrated oxide alone. That being the state of things, Mr. Croll proceeds, and of course the learned counsel for the defendants says to you, that you must take this specification to mean hydrated oxide of iron, because the supposition at that time was, that that only would succeed; and possibly that would be the case, until recent experiments have shown the converse. Mr. Croll's specification goes on—"This material, after it has ceased to absorb the sulphuretted hydrogen, is to be removed from the purifying vessel and roasted in an oven to expel the sulphur which it then contains. After this material has become thoroughly red in the oven, I have found from two to three hours' further time to be sufficient to accomplish this object, taking care that whilst it is being roasted it be well stirred about in the oven. After this operation is completed, the material is fit again to be employed by being placed in the purifier moistened with water as in the first instance." Upon that the witnesses for the plaintiff say,—"It is manifest that this indicates an anhydrous oxide; at all events, it would have become so on the second occasion, because the treatment there spoken of would be such as to unhydrate the oxide." The witnesses for the defendants, on the other hand, say—"Not so;" and they say that you may apply to manganese such a heat as, while it would expel the sulphur, would not unhydrate it. And they say, further, that whereas the first part of the specification in the then state of knowledge pointed to the use of hydrated oxide, the second part, which says that it is to be roasted, does not point to its being anhydrous, because a hydrated oxide may be roasted and still continue hydrated. Gentlemen, the learned counsel for the defendants says—"How could Mr. Croll be supposed to have meant an anhydrous oxide, when it was understood at the time that an anhydrous oxide would not operate?" Upon which the learned counsel for the plaintiff says—"How could Mr. Croll be supposed to mean a hydrated oxide, when he shows you a process which would convert it into an anhydrous oxide?" Both the learned

counsel, therefore, submit to you that Mr. Croll's process was an impossible one—that is to say, the defendants' counsel says he could not mean an anhydrous because that would not operate, and the plaintiff's counsel says it could not remain a hydrate because the process which he describes would make it anhydrous. Now, that is what the specification says upon the face of it; and it is a matter for you to decide and not me, and therefore I cannot speculate as to what your conclusion will be. I believe I have stated to you what are the facts in connexion with this point, and they may lead you to the conclusion that the person who was specifying did there indicate the use of both kinds of oxides, not himself knowing very clearly at the time what the right of the matter was. It certainly would not be an unreasonable construction to put upon this patent with the additional light which we have upon the subject, because Mr. Croll has been called before you, and he says—"I did not know whether the black oxide of manganese was hydrated or not. I knew nothing about the matter, except that the black oxide would do, whether hydrated or not. I did not know nor care, so as it answered my purpose;" and I may remind you that he also said he did not know how the sulphur was got rid of. Of course when a man says, "What is true of manganese is true of iron," and his specification points to an anhydrous oxide of manganese, one would say that he also intends to specify the use of an anhydrous oxide of iron; but if it is to be read as meaning, "I take either oxides, not being aware that the one is more useful than the other," then it would indicate, and, in fact, would be a direction, that whatever was an oxide of a metal would do, whether hydrated or anhydrous. That seems to be the reasoning upon the subject, and really, gentlemen, it is for you to bring your intelligence to bear upon it and to say what it really does mean. Mind, you have not got to consider what a moderate workman or one who is not a chemist would say upon this point, but what it discloses to those with competent knowledge and understanding. If it discloses the use of an anhydrous oxide, then it does not disclose what the plaintiff claims in his patent; but if it discloses both hydrated and anhydrous oxides, then it would be difficult to say how, in that case, the plaintiff can be said to have invented the use of it. The question is not whether it is somewhat obscure, but what does it tell to people who take pains to understand it, and have proper intelligence and science to enable them to comprehend it. You are urged by the plaintiff, upon the face of the specification, to say that it must be an anhydrous oxide only, because that is the material to which the process would reduce it on the second occasion; and by the defendants you are asked to say that it must mean hydrated only, because at that time it was thought that hydrates alone would purify. I do not know that either of the learned counsel for the defendants suggested that it might mean both. Mr. Bovill certainly did; and if it means both, it may mean either. Now we come to what it is Mr. Croll states that he did. I am supposing that he did not specify at all, so far as that was a means of publication. I think I need not read over his evidence; you have heard what he did. He says: "I got the black oxide of manganese, and I used it as here described. I did not roast it as here described, because I found that placing it on the hot retorts, which did not bring it to a red heat, and therefore would not make it anhydrous, was sufficient to drive off the sulphuretted hydrogen." So that the material would still be hydrated, if it were so in the first instance. But then we have a controversy, as I understand it, as to what black oxide of manganese is. I do not know that we have had any evidence given upon the point except that given by Mr. Herapath, who says the black oxide of manganese is more commonly a hydrated oxide than an anhydrous one. Therefore, if that be so, Mr. Croll might have used a hydrated oxide; and Mr. Croll describes the mode which he adopted, and which would not render it anhydrous supposing it to have been hydrated in the first instance. It has been said to you that it *may* have been anhydrous in the first instance, and that he might have used it entirely as such. But then Mr. Croll, although the thing he puts prominently forward is black oxide of manganese, himself practised with sulphate of iron, which, no doubt, was a hydrated oxide; and therefore, adopting Mr. Herapath's views, it is more likely than not that the manganese was also a hydrated oxide. If you should be of opinion, independently of this specification, that Mr. Croll carried on his proceedings to such an extent as to carry them beyond the idea of mere experiments to which I have adverted, and carried them on so that we may say there was an open and public exercise of the use of the hydrated oxide of iron in 1841, then it is perfectly clear that the plaintiff's subsequent invention was not a new one. [The learned judge having read over Mr. Croll's evidence on the point, proceeded:] Well, now, gentlemen, it is for you to say whether this goes beyond a mere experiment, and I shall say nothing more to you about Croll's patent or practice. Does his specification disclose the use of hydrated oxide of iron? If it means oxides in general, it does. There was a verbal criticism at the time upon the word "oxides" which really comes to nothing, because he himself did not use it to signify either. Does his specification point out the use of hydrated oxides alone, or hydrated, or anhydrous? or does it point out the use of the anhydrous only? Was his practice beyond an experiment, in the sense which I have described to you? When a man talks of purifying 20,000 feet of gas a day, and carrying that on for a long time after he has taken out his patent, and of using both manganese and iron, it certainly does look like the practice of the thing; but you may still think it was not such a use as would prevent a subsequent inventor, in the sense in which I have explained it to you, being considered the inventor of a new matter. Of course, if you are satisfied of either of these matters, you cannot say that Hills invented the use of the hydrated oxide of iron as claimed by him. If you are not satisfied of either, then Mr. Croll's patent and practice are no impediments to Mr. Hills' invention being considered a novelty. If you find that Mr. Hills' is not new upon that score, tell me whether it is on account of Croll's specification or of his practice. I should say you are well entitled to consider, and say whether, altogether, they form such a publication that Hills' invention, supposing him to have invented it, was or was not a novelty; and you may as well bear that in mind, because it is impossible to say what the two combined may make known to the public, if either of them separately will not do it; because, if this is an ambiguous matter upon the face of it, by reference to the actual practice it may be said the public were put in possession of the secret which Croll in reality had found out, though he did not know why. I have now done with Croll and his specification, and it will be for you to say whether, upon a consideration of that, you are of opinion that the first part of the plaintiff's invention is new. And now, gentlemen, I come to the other and more complicated question which arises upon Laming's patent. I have reminded you that no part of Hills' patent is for the preparation of the hydrated oxide. I need not, therefore, say more here, than just suggest it to your minds again. But there is a very remarkable thing arising in reference to this particular matter. I do not know what your opinion is upon the matter which has been sworn to before you on the part of the defendants, and not, as I understand, contradicted on the part of the plaintiff. It is sworn on the part of the defendants that the best way to use the hydrated oxide of iron is to use it in conjunction with the sulphate of lime or the muriate of lime. You will remember that Mr. Thompson—who, I may venture to say, is a very intelligent man—tells you, if you had the hydrated oxide in a separate form, the best way in which you could use it to purify gas would be to mix it either with chloride of calcium or sulphate of lime; and he said that, *à fortiori*, if you had them combined in the way in which you prepared them, it would be better to use them together; and he gives you a reason for it. He says the reason is, that you then purify the gas both from the ammonia which is in it and from the sulphuretted hydrogen at one operation; whereas if you were to have the hydrated oxide of iron only, the ammonia would pass through, and it would have to be separated by a different process, or you must take it away first. And, gentlemen, you have an affirmation of that statement from Mr. Owen, to whom I put the question just now. He tells you that the stuff which he prepares under the plaintiff's patent is not unmixed hydrated oxide of iron, but that it is a compound of hydrated oxide of iron and of sulphate of lime. You may take it, therefore, that Mr. Thompson's statement is a correct one, and that the best mode of using hydrated oxide of iron is in conjunction with lime, either as a sulphate or a muriate. Mr. Hills says,—"I take the subsulphates, the oxychlorides, or the hydrated or precipitated oxides of iron, which I prefer to use in rather a damp state, *either by themselves*"—I beg your particular attention to this—"*or mixed with sulphate of lime, or sulphate or muriate of magnesia*, baryta, strontia, potash, or soda." So that, when he uses lime, it is a sulphate only, and not a muriate; but when he uses magnesia, it is a sulphate or a muriate. Now, one can suppose, therefore, that when he drew this specification he had passing in his mind muriate of lime; because almost immediately following the words "sulphate of lime" are the words "muriate of magnesia;" and we must suppose, therefore, that he designedly left out the word when speaking of the former, and said, "I mix it with sulphate of lime, or a sulphate or muriate of magnesia;" in other words—"Take a muriate indifferently with a sulphate of any other matter, but not of lime." Now, I have reminded you that the preparation of this hydrated oxide of iron is no part of his patent; but he says that "hydrated or precipitated oxides of iron may be conveniently prepared for these purposes by decomposing sulphate or muriate of iron with hydrosulphuret of ammonia, or with lime, magnesia, potash, or soda." So that he would, you see, prepare his hydrated oxide with lime and a "muriate of iron;" and yet when stating the way in which to use it, he has dropped the muriate of lime. Now, gentlemen, I pause here for a moment, as I am obliged to take up a fresh thread before proceeding in this matter. He says: "Hydrated or precipitated oxide of iron may be conveniently prepared by decomposing sulphate or muriate or iron with hydro-sulphuret of ammonia, or with lime, &c." Now, it is obvious that that is, as one may say, an inaccuracy, in the sense of being an incomplete description. They are not so prepared; that alone would not produce a hydrated oxide of iron, because it is admitted on all hands that the thing precipitated would be a carbonate of iron, and that you would have, in the first instance, mechanically combined, a carbonate of iron and a sulphate or muriate of lime, magnesia, potash, or soda, as the case may be. He goes on to say—"They may then be absorbed into or mixed with sawdust, peat, charcoal, or breeze, or other such material, and afterwards exposed to the air." Now, gentlemen, do not suppose that I am indulging in any verbal criticism—a thing I detest at all times, and rarely see any necessity for it—but the substance which he says you may procure or prepare as hydrated oxide of iron, is, by the process described, in the first instance a carbonate, and only by exposure to the air becomes a hydrated oxide. Now that is the whole of what he says. They say you may explain the entire statement by saying you may procure a mixture of hydrated oxide of iron and sulphate of lime by putting hydrate of lime and a sulphate of iron together, precipitating it, getting a carbonate in the first place, and then by exposing it to the air converting it into an oxide, and then you may use it so prepared. But although he speaks of the hydrated oxide mixed with something, yet when he states to you the mode of preparation, it is manifest that what he states is this: "Though I do not claim the preparation of either of the mixtures, yet I will show you how you may make a mechanical mixture of both; and then I will show you how you may use the two together in the purification of gas." Now that is the plaintiff's patent. Let us see what Laming's is;—and I am afraid that I have here got the third thread to which I must call your attention. I quite agree with the Attorney-General, that the first part of Laming's invention is for improvements in the mode of purifying coal gas by chloride of calcium; and when he states that "Chloride of calcium is both abundant and cheap, but under certain circumstances it may be desirable to make it, for the purposes of gas purification, by decomposing muriate of iron by means of lime, or of chalk when the latter will suffice. In such case the oxides or carbonates which result are useful for the said purification and need not be removed,"—I say that statement has nothing at all to do with the statement at the top of the paragraph; and certainly if Mr. Laming had any notion in this part of his invention of using an oxide, he employed very questionable words for the purpose of stating it. The learned counsel for the defendants says to you that Mr. Laming is a crafty person; he knew he could not, in so many words, claim the use of an oxide, because that was in Croll's patent, and therefore he thought he would do it on the sly in the way pointed out. Whether that is so, I really do not know; but certainly it is very suspicious against Mr. Laming that he does not say what he proposes to purify by the chloride of calcium. He does not say, I mean to purify from ammonia; and yet it is quite clear that it does not purify from anything else. It may therefore be that what Mr. Laming means is very apparent, but that he was afraid to say so. But to my mind it is not very material what Mr. Laming wanted to do—what he has actually stated is chloride of calcium may be prepared by decomposing muriate of iron by means of lime or chalk; and that "in such cases the oxides or carbonates which result are useful for the said purification and need not be removed." Why, they are not only "useful for the said purification," but, as far as the sulphuretted hydrogen is concerned, they are essential; because the chloride of calcium does not purify from that at all. "I do not claim," he says, "either of these processes for making a mixture of chloride of calcium and a metallic oxide or carbonate, but "—and here we come to another head of claim—"I do claim the application of mixtures so made to the purification of coal gas." It may be that you will think that the claim there made removes from him the imputation of being as cunning as Mr. Bovill says he was, because he there claims only the application of the mixtures so made. Now, gentlemen, we have had a controversy as to whether an oxide is a carbonate. I do not know that I should be safe in laying down the law to you, as I believe it to be correct; but I venture to say this, that you twelve gentlemen are thoroughly persuaded that when Laming specified carbonate of iron, it was not understood to be an oxide. It is absolutely idle to suppose that it was. The druggists, and those who dealt with them, might call the article they sold carbonate, which in such establishments as Apothecaries' Hall and Bell's had 95 per cent. of oxide in it; and physicians and druggists,

in deference to the old practice and for convenience, might continue to call carbonate of iron *ferri carb.*; but to say that it has been established in evidence that the carbonate was an oxide, is so idle that I will not say a word about it; and I cannot think it matters, because the question is not what Laming has called the thing, but what he has shown the thing to be. What has he shown the thing to be? He has shown it to be that which results from the decomposition of muriate of iron by means of lime. And what do you then get?—you get a muriate of lime and a protoxide of iron, which by exposure results in a peroxide of iron; so that Laming here describes to you the preparation of a mechanical mixture, the use of which he claims,—which mechanical mixture consists of muriate of lime and the oxide of iron. He claims, mind you, the use of a mixture identical with one which is not claimed by Hills, but which he shows the mode of making. You know Hills has said, "I get my oxides by decomposing sulphate or muriate of iron with hydro-sulphuret of ammonia or with lime," &c.; and Laming says, "I claim the use of mixtures so made to the purification of coal gas." The plaintiff does not claim the use of the mixture of the muriate of lime, and it is a very remarkable thing that he says he prefers to use it mixed with sulphate of lime or with sulphate or muriate of magnesia, &c; so that when he is describing a way in which he uses it, he says, "I take the sulphate, and use it with or without the other." Oddly enough, we find that Laming uses the muriate and not the sulphate. Hills says, when speaking of lime, "I use the sulphate;" but when speaking of magnesia, baryta, strontia, potash, or soda, he uses the sulphates or muriates. Now, gentlemen, I do not know how it occurs to you, but it appears to me quite clear, that while Laming says, "I claim the use of the mixture of the hydrated oxide of iron with the muriate of lime," Hills says he claims the hydrated oxide of iron with sulphate of lime. Hills says, "I get my hydrate by the use of sulphate of iron." If he had said, "I claim the muriate," it would have been identically the same thing; and it certainly is curious that he leaves out that word. I do not know whether you follow me here. I say, if he had prepared his hydrated oxide of iron by using muriate of iron and lime, which he says he does, and had then used that mixture, it really would be the identical mixture which Laming in his patent claims. One does not see very well—but, as I said before, do not adopt what I say upon a matter of fact—one does not see very well why Hills should prepare his oxide of iron, and point out a mode of doing it with muriate of lime, and then omit to mention muriate of lime in his claim, unless it was that he felt it was identically the same thing as Laming's; and you may be of opinion that the difference between these two is a difference of that character which I described when I spoke of the substitution of a mechanical equivalent,—that it is an immaterial difference, and that what one does is inevitably done by the other. You have had called before you Mr. Owen, who has just made a statement to the effect that the chloride of calcium, or the muriate of lime, is a bad thing to use in conjunction with oxide of iron for the purification of gas, because it is deliquescent. On the other hand, you have had Mr. Thompson called before you, and he tells you that the two things are identically the same—equally useful and commercially as good; because, though you may often get sulphate of iron as cheap as muriate, yet there are places where you can get the muriate much cheaper. But supposing the suggestion on the part of the plaintiff to be a well-founded one—viz., that chloride of calcium is a bad thing to use with the oxide—one would have thought that Mr. Hills would not have put in this part of his specification a statement of the mode of preparing hydrated oxide of iron by the use of muriate of iron with lime: because if it is an objectionable mode, not of using, but of preparing hydrated oxide, because it results in a mixture of a deliquescent character, and is inconvenient,—whereas you had better prepare it in such a way that it would result in a mixture that is not a deliquescent one,—you would think that Mr. Hills would have said, "It may be conveniently prepared by decomposing sulphate of iron with lime, but is not convenient to do it with muriate, because of its deliquescent character." You can hardly say that it was not intentional, and you know that he was perfectly safe in claiming magnesia, baryta, strontia, potash, or soda, because Mr. Laming, in his specification, had not mentioned a word about them. Gentlemen, I do not know whether I have made myself intelligible to you, but the result is this—The plaintiff says, "I claim hydrated oxide of iron, but I claim to use it either alone or in connexion with the mixture of sawdust, breeze, &c.; and I will tell you how I prepare it. I decompose sulphate or muriate of iron with hydro-sulphuret of ammonia, or with lime, &c., &c., and the result is, they produce that mixture which I prefer to use." He says: "I take the sub-sulphates, the oxychlorides, or the hydrated or precipitated oxides of iron, which I prefer to use in rather a damp state, either by themselves or mixed with sulphate of lime, or sulphate or muriate of magnesia, &c., &c.." I do not, and it is for you to say if you can, discover in this thing any novelty. No doubt there is this difference—that he says, "I use it with the sulphate of lime;" the other man says, "I use it with the muriate of lime;" and the plaintiff says, "I use it either with sulphate or muriate of magnesia, baryta, strontia, potash, or soda." If there appears to you to be a substantial difference between them, then the plaintiff's is a novelty; but if you should be of opinion that he has left out muriate of lime,—because, if he had not done so, he would have put down in words the thing which the other man had done before him,—you will look upon it as a colourable alteration only; or should you think that what Laming has said, though not in words, would inevitably suggest it,—and of course no man can doubt that oxide of iron prepared from sulphate of iron is capable of absorbing sulphuretted hydrogen as well as the other prepared from muriate of iron,—then this is no novelty. It is for you upon this part of the case to say whether it is a novelty or not. If you say it is not new, or that if it is not the same thing the difference has been put in for the purpose of making a difference, then I say there is no novelty which can be claimed on this part of the process. I do not know that I need trouble you with the other parts of the case. You know what has been said about gas liquor. Hills says, "I use hydro-sulphuret of ammonia, and I use it in connexion with the sulphate or muriate of iron;" and Laming says, "I throw down from ammoniacal or gas liquor obtained in making coal gas, and previously distilled or not, the sulphur which it contains, and having drawn off the clear liquid, I next precipitate its carbonic acid, or instead of making two separate precipitates, I throw down a mixed sulphuret and carbonate of the precipitant. I prefer to precipitate by means of the muriate or sulphate of iron." Now, I have reminded you that, with respect to this part of the case, all the claim by Laming is a claim not for the preparation of the mixture, but for the use of this preparation, which he calls a carbonate, and which we now know results in an oxide. Well, that oxide being so obtained, is in the end a hydrated oxide; and he says, "I do not claim either of these ways of making a metallic carbonate, but I claim the use of the carbonate above named, however obtained, for the purification of coal gas." But when I tell you that ultimately it is a hydrated oxide, you ought to bear this in mind, that it is not the same thing, though it ultimately becomes so after an exposure of more or less length to the air, according to its bulk. You are, therefore, not to suppose that this is a claim for a hydrated oxide under another name. It really may mean that this is a claim to the use of the carbonate only, and does not show the use of an oxide. I should remind you, however, that the witnesses swear that you could not practically use it by putting it in a porous material without its inevitably becoming an oxide. Now, gentlemen, I do not know that I need trouble you at any greater length on Laming's specification. It will be for you to say whether by words or by necessary inference he discloses what the plaintiff claims to be his invention—viz., the hydrated oxide of iron. Of course you have also to consider what claim he does make. I do not think that, with respect to him, there is that public user, which, if no patent had been obtained by him, anything which had been done by him was such that the plaintiff could be said to be not the inventor. I now proceed to call your attention to the other question, which is one of considerable importance in every point of view. You have been exhorted on both sides not to lose sight of that view which is favourable to themselves. So be it; but I may remind you that, whatever desire you may have to maintain a patent, you cannot do so if the law is against it. It is very desirable that a man should be protected in the possession and enjoyment of any invention of which he is the author; on the other hand, it is certainly not desirable that that which is common property should be appropriated by any one as his own, when it is really not so; and what Mr. Bovill says is a perfectly right and correct remark, if a man will claim in his patent that which does not belong to him, however hard it may appear to him, he must take the consequence; he is not entitled to it, and the whole thing must go. You must decide the case according to law; and the law is, that if one part of the patent cannot be maintained, the whole must go. I have now to address you upon that question which depends upon whether he was the discoverer of the process of renovation, and this relates to the second part of his claim. Now there are some things which appear to me to be absolutely clear, but, however, they are matters of fact for you. I think there can be no doubt—and I do not understand the learned Attorney-General to make a doubt—that Laming had in 1849, when he specified at Paris, discovered that the hydrated oxide of iron could be renovated. I think there can be no doubt of that. I think also there can be no doubt, whatever may be said in other respects as affecting Mr. Evans's memory—I say there can be no doubt that Mr. Evans knew of that fact in the year 1849. It is true, and the learned Attorney-General has made that comment to you, and you ought to take it into consideration, that though Laming and Evans thought they had discovered it, they had not done so, because when they tried it on a large scale in December, 1849, it failed; and therefore the learned Attorney-General says, though in one sense they had discovered it, they had only an inkling of it, and had not really discovered the thing itself. On the other side it is said, that is not so; they had discovered it, and the reason the large experiment failed was because there was an excessively cold winter; and you will remember that the explanation was—the parts had crystallized, and the consequence was, the oxide was inaccessible to the oxygen, and so did not get re-oxidized. As to that matter, no doubt, if they had only got an inkling of the thing, it would be difficult to say that they were the inventors; but I do not think it is material, and I will tell you why. The question is not whether they invented, but whether Hills learnt his process from them. If you should be of opinion that he did, then, although they had not perfected the thing for all time and circumstances, it matters not; he is not entitled to be considered the inventor. It seems to me to be really clear that they had found out that principle in what one may call a more or less perfect way in 1848. It really does not admit of dispute. You have before you the French patent, which shows clearly that Laming had found it out; you have before you Mr. Evans, who brings with him books which show that in August, 1849, a series of experiments were made at the Chartered Gas-Works with oxide of iron, and upon oath he tells you that he, Evans, had discovered that the oxide, after being exposed to the air after the process of purification had been carried on, would become renovated. I think, gentlemen, that is a discovery; but, as I said to you at the outset, if they had not a patent for it, and did not make it known to the world, the question is whether Hills learnt his secret from them. That is really the question; for if they communicated the secret to him, or if he got to see their experiments and learnt it from them, he is not the inventor; he is really a person who has pillaged a secret. Now let us see what the evidence is. Do not suppose for a moment that I am going to urge upon you any topic which would indicate any opinion that I have formed, it is only that I may assist you in forming an opinion upon the matter. There is no doubt that Laming had found it out, and that in August, 1849, there were experiments going on at the gas-works with the material. There can be no dispute but that the oxide was thrown down, that it became red, that it was visible to every one, and that the subject was a matter of conversation in the yard; because you have not only had it from Mr. Laming and Mr. Evans, but their testimony is supported by the workmen who saw the stuff, noticed that it turned red, remembered that it was the subject of conversation, and that the directors were brought down to see it; and it is also quite clear that in August, 1849, there were experiments made upon it. It is also clear that the plaintiff Hills had certain experiments going on in the yard at the scrubber; and it is admitted by him that on one occasion, subsequent to the experiments being carried on by Laming and Evans, he (the plaintiff) was at the yard; so that one would say he had an opportunity of being informed of the matter by Evans, and of seeing what was going on at the time. One would be inclined to think, too, that if, as he says, he had at that time made the discovery himself, his attention would be arrested by the sight of the red oxide lying about there. A man who himself had discovered the matter would, you would think, have his attention directed to this fact somehow. On the other hand, if he had not discovered it, why there's an end of the matter. It seems, therefore, clear the thing had been known to Laming and Evans, and it is probable or possible that the plaintiff had an opportunity of seeing what was going on. Then there is another thing—no doubt the plaintiff's brother was there on several occasions. Upon these matters there is no doubt; unhappily, upon others there is a considerable quantity of doubt; and there are some matters which will weigh with more or less of weight upon your minds. The first thing that Mr. Bovill says is this:—"How strange it is that Hills should have invented this in 1848, and that he should have taken out a patent in that year and not put it in, but should have waited for a year afterwards before he did so." Mr. Hills, on the other hand, says—"There is nothing strange in it; for though I had invented it in 1848, I had not perfected it; and it is all very well for you to say the title of the patent which I took out in that year would have comprehended it—I do not think so." And then he says, "I waited till November, 1849, because I had been continually making experiments upon it, and because I had other things which I wished to include in that patent." Now, gentlemen, Mr. Bovill says: "Do you think that a man so thoroughly versed in patents, and always having some scheme in hand, and who, when he hands in a deposit-note, hands in a note of the crudest notions in his brain—is it at all likely that he would not have got the title of his

1848 patent sufficiently wide to put this in, or that he would not have got a separate patent earlier?" I have reminded you that there are reasons why that should not have been done; but these are points for you to take into your consideration. And there is another point upon which Mr. Bovill makes great comment, and I frankly own that I think it is well deserving of your serious consideration. You know by this time what the practice is in reference to taking out patents. A man takes out a patent and there is some opposition to it. The Attorney-General says—"Hand me in a statement of what your invention is." In this case I will warrant that there is not one of you gentlemen who would not, in twenty words, have tersely described the subject-matter of the plaintiff's patent. Let me try: "I claim the purification of gas from sulphuretted hydrogen by passing it through hydrated oxide of iron, and also the renovation of that material by exposure to the air." Would not that be a ready mode of expressing it? Would not that occur to any scientific person? It might not be complete, but at all events it would be correct; and one would think that if that were the proper mode it is one that Mr. Hills would have adopted. But what does he say? "My fifth claim is for absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again, either by heat, &c., or taking off the atmospheric pressure." Now, gentlemen, I do not say, because it is for you to determine, whether his patent is good upon that point; but I think it shows that he did not know of this invention at the time, or did not intend to claim it. The importance of this deposit-paper is to show that he had not upon his mind at the time he wrote it that he was the inventor, either because he did not know of it, or because, though he did know of it, he did not intend to claim it. I do not say, because it is for you to say whether this does or does not lead to his invention—but certainly, to my mind, if it does, it is by the most happy accident in the world, and I cannot understand how any one intending to describe Mr. Hills' invention could have used language which, to my mind, is so inappropriate as that which he has used. I have said that I detest those minute verbal criticisms which we lawyers are reproached for indulging in, though I think the reproach is often cast by those who perhaps do not possess so much intelligence as ourselves; but after all, a man can be but right. What is the emphatic word here? It is the adjective "porous," and one may infer, therefore, that he meant any body, provided it was porous. But in his real invention, at least in that which he is now claiming, although, indeed, the body which he uses is porous, its value is not on account of its porosity. No doubt he uses a porous body, but no doubt, also, the porosity of that body is not the cause of its efficient action; it is only a mode by which the thing that acts effectually is enabled so to act; and it does seem strange that a man so thoroughly acquainted with these matters should use language of this description. Another remark is this—"and removing them again by heat, &c., or taking off the atmospheric pressure." Now, it is true that if you do take off the atmospheric pressure, either from above or below, the air will be driven through the material, and that will purify and renovate it; but then, if instead of taking off the atmospheric pressure you were to blow through it with a pair of bellows, a similar result would follow; and therefore this is not the efficient agent, but only that by which the efficient agent works. Now, it would be impossible for me to comment upon that matter to you without expressing my feeling of astonishment that Hills should use this expression—but, as I said before, you must discard that from your minds. If you think this was the natural and proper mode of describing this invention, that relieves Mr. Hills from the imputation; if not, it is not decisive against him—it is only corroborative of Mr. Bovill's theory, that at the time he did not know of this invention, or, knowing, did not intend to claim it. I should remind you that at that time he was trying experiments with sawdust at the gas-works, where the hydrated oxide of iron was being employed for the purpose of purifying gas. It occurred to me, supposing this is not a proper mode of describing what he now claims, what does it describe? Accordingly, I asked Mr. Campbell whether sulphuretted hydrogen would be at all detained or absorbed by a porous body, such as sawdust, in the passage of the gas through it. He said: "Yes, it would." I then asked—"Would it be that the simple removal of atmospheric pressure from it, would cause that gas to be given off?" He said it would. It struck me at first, therefore, that Hills might mean such a thing as the simple use of sawdust, which he was practising upon at the time; but then I must tell you that Mr. Campbell says that such a thing could not be beneficially done. I must also tell you that this deposit-note does not bind a man to go on with his patent. If he finds it will not answer afterwards, he may abandon it; and I do not think it any disparagement to Mr. Hills to say that perhaps he had in his head at the time that you might absorb the sulphuretted hydrogen in a porous body, and then get rid of it by atmospheric pressure. But it is for you, gentlemen, to say if in your minds that language indicates that he was not aware at the time of his present invention,—if so, it is a difficulty in his way; if not, it is no difficulty at all. Now we come to the evidence upon the subject. Mr. Evans swears that he told Mr. Hills, and Mr. Hills swears that he did not. [The learned judge read portions of the evidence on this point, and commented upon them.] It had been suggested—he said—that Evans was mistaken as to the day on which he said he told Hills; but from the evidence he had read, it did not prove that he was wrong, though it weakened his testimony. Unhappily, he might say, both of these gentlemen got a certain amount of corroboration to their statements; and Mr. Thompson was called, who proved that at the time when Evans had no cause to invent such a statement, he told Mr. Thompson that he had informed Hills. It did not appear that Mr. Thompson had any interest in coming forward to state an untruth; and certainly they were justified in supposing, when a gentleman of his position swore to a conversation, such a conversation had certainly taken place; and, if so, there was a very strong corroboration that Evans did tell Hills. On the other hand, the plaintiff said—"I will show you that I was not told, because I knew it before;" and on that point they had the evidence of Mr. Dale and Mr. Barnard, which his lordship read over. He then referred to the observations of the Attorney-General as to what course it would be supposed Evans and Laming would have adopted had Hills obtained a patent for what was their invention. They might—said his lordship—have taken out a *scire facias* to repeal the plaintiff's patent; but though that would have taken it away from him, it would not have given it to them, and therefore the proceeding could only have gratified a feeling of revenge. That, again, was a topic which the jury would have to consider. Another remark made was this:—It was stated that Hills' patent of 1849 was attacked by *scire facias* by Laming, and that it terminated in an arrangement; and that had been relied upon as proving an acknowledgment by Laming of Hills' invention. As he understood that matter, it was so in this sense: though Laming said I claim the use of all the oxides in my patent of 1849, yet I am content to admit that whatever is claimed in your patent should be considered as new, and I will pay a royalty upon it; but he must remind the jury that the only importance of this was to show what was Laming's opinion in 1852. And then, too, he thought he ought to remind them that, to use an old proverb, "Half a loaf is better than no bread." The only good that could be got by opposing Hills' patent was, if successful, to make a present of what was contained in it to the world. But if they agreed between them that it should be considered a good patent, and a licence was to be granted to Laming for the use of it, he would get something out of it; in fact, as he understood Mr. Owen, he was making a profit out of it by selling Hills' preparation to the gas companies. Of course, the public not being parties to this arrangement, their interests were lost sight of, and these gentlemen said—"Let us share the results between ourselves." By that arrangement Laming, no doubt, was content to admit that Hills was the patentee, on condition of being allowed to have a profit out of the invention. It was a matter entirely for the jury to say whether they considered this view of the arrangement was perfectly consistent with the fact of Laming being the inventor, and Hills the borrower of this invention from Evans. The learned judge said he had now gone through the matter as minutely as he considered necessary, and he would not trouble the jury with further reference to the evidence, unless they would like him to read through the two hundred pages of his notes. If there should be any question of law upon which they desired his advice, he should be happy to assist them; but it seemed to him that the questions they had to consider were two: first, Is the invention new as a whole, or in any of its parts? and if it is new, Is it the invention of the plaintiff?

At the request of the jury, the learned judge handed them in writing the questions on which he desired their opinion.

Mr. CHAMBERS asked that the further question might be left to the jury, whether this matter had been communicated to Mr. Hills, because that involved a question of character, of more importance than the patent itself.

Baron BRAMWELL said he could not ask the jury to say whether Evans told Hills; all he could ask them was, whether the invention specified was an invention which he learned from others. It was for the jury to form their conclusion from the facts given in evidence, and if they were of opinion that, in part or whole, he learnt it in the way he had described, and that the alterations to which he again referred were only colourable ones, then the plaintiff was not entitled to their verdict.

In answer to a question by a juryman,

Baron BRAMWELL said: We are not here to say whether Croll's specification is a good one; but I should say that, if Croll's specification indicates the use of hydrated oxides, then he has made it known to the world, and Hills cannot claim anything new in it. When a man uses the general term "oxides," and does not discriminate between the two, we should say, *primâ facie*, that he meant any oxide.

Mr. DENMAN said he understood the question was—Supposing Croll did mean any oxide, could Hills take out a patent?

Baron BRAMWELL said he understood it to be, What was the meaning of these documents?

The jury then retired to consider their verdict, and were absent half an hour. On their return to the court,

The FOREMAN said: We find our verdict for the plaintiff; we answer all the questions in the affirmative.

Baron BRAMWELL: Each part is new, and the whole is new; each part is the invention of the plaintiff, and the whole is his invention?

FOREMAN: Yes.

Baron BRAMWELL: Gentlemen, I believe those are all the questions which I put to you. Now, Mr. Bovill, what do you say?

Mr. BOVILL: That, upon the construction of Croll's specification and——

Baron BRAMWELL: I suppose you will say that upon Croll's and Laming's specification too, you are entitled to enter the verdict for the defendants?

Mr. BOVILL: Yes, my lord; also upon the sixth plea, in reference to the paper of deposit.

Baron BRAMWELL: Let me understand this. How do you say, that the invention was not intended?

Mr. BOVILL: That the invention described in the specification is different to that for which the patent was granted. The patent was granted for what is set forth in the deposit-paper, and not that which is in the specification.

Baron BRAMWELL: I am very clearly of opinion that that is not a question of law, but of fact—obviously so, and I will ask the opinion of the jury upon it. (To the jury:) Gentlemen, I suppose you will have no difficulty in saying after your verdict that the invention, whether happily expressed on this paper or not, is that for which the patent was granted?

The JURY: Yes, it was.

Mr. BOVILL: Then there's another point.

Baron BRAMWELL: I do not think I ought to reserve the last point, for I am clearly of opinion it is not a question of law; but I do not care.

Mr. BOVILL: It will do no harm.

Baron BRAMWELL: It cannot be a question of law, because, supposing he had left it out of his patent altogether, and swore that he had put it in? Mr. Chambers, perhaps we had better let it go.

Mr. CHAMBERS: Whatever is right—I cannot object to that.

Baron BRAMWELL: I think we may safely agree that Mr. Bovill may have leave to move on that point, because I am very sure it is not a question of law. I will only reserve you leave on the understanding that you do not appeal on that point, which would thus be giving you the opportunity of harassing the plaintiff. I do not use the word offensively.

Mr. BOVILL: There is no intention to do that; I would rather take my chance. Then, my lord, I contend that this was not the subject-matter of a patent, the principle being well-known.

Baron BRAMWELL: I think you may fairly move on that ground.

Mr. BOVILL: Then that the specification is bad on the ground that he claims all hydrated oxides, whereas some will not purify, and he does not show which he uses. Then there's another ground—which is, that he does not show how it is to be done. He describes muriate of iron and lime, which his own witnesses say will not answer.

Baron BRAMWELL: That will do.

Mr. BOVILL: Then there is another point—viz., that the renovation process is not the subject of a patent; it is the mere description of a principle. Then there is the point reserved on the last occasion—viz., that the specification is not within the amended title, especially with reference to the reviving, and that the disclaimer is not authorized by the Act.

Baron BRAMWELL: I will say, "Leave to enter nonsuit on all the grounds except on that of the deposit-note."

Mr. BOVILL: It will be for your lordship to construe this deposit-note; and if so, that would be a point reserved.

Baron BRAMWELL: I think not.

Mr. BOVILL: If it is for your lordship to construe the specification, then it is for your lordship to——

Baron BRAMWELL: Mr. Chambers, I think there is nothing in it, and you perhaps had better let him have it.

Mr. CHAMBERS: Very well, my lord.

The verdict was then entered for the plaintiff—damages, five guineas—the points of law being reserved.

London: Printed by WILLIAM BOUGHTON KING (at the office of Joseph Clayton, 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court Fleet Street, in the City of London.—Tuesday, Aug. 31, 1858.